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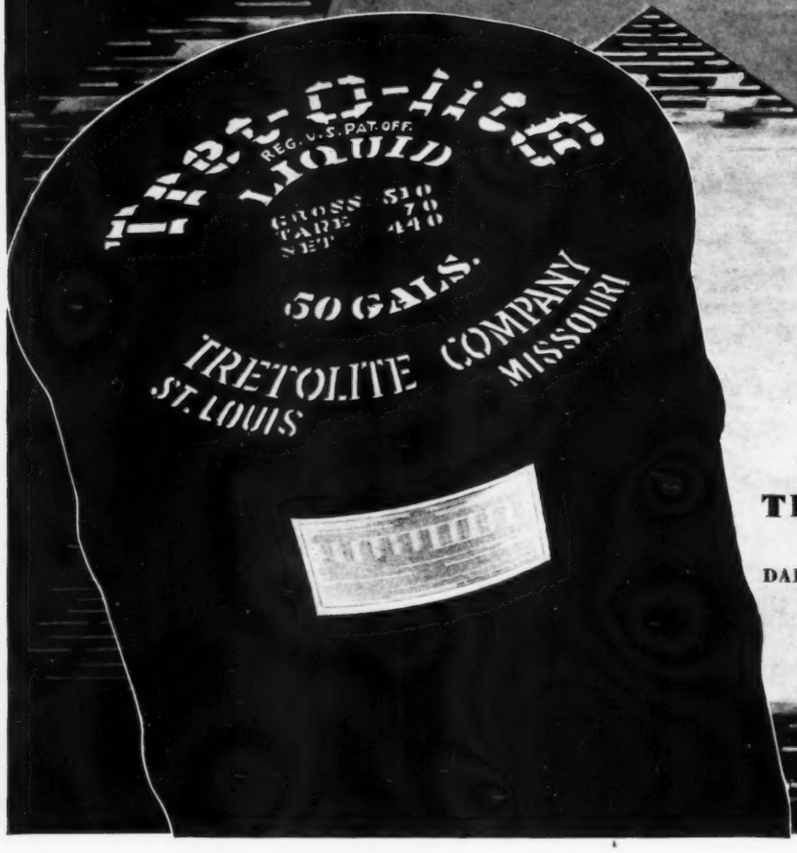

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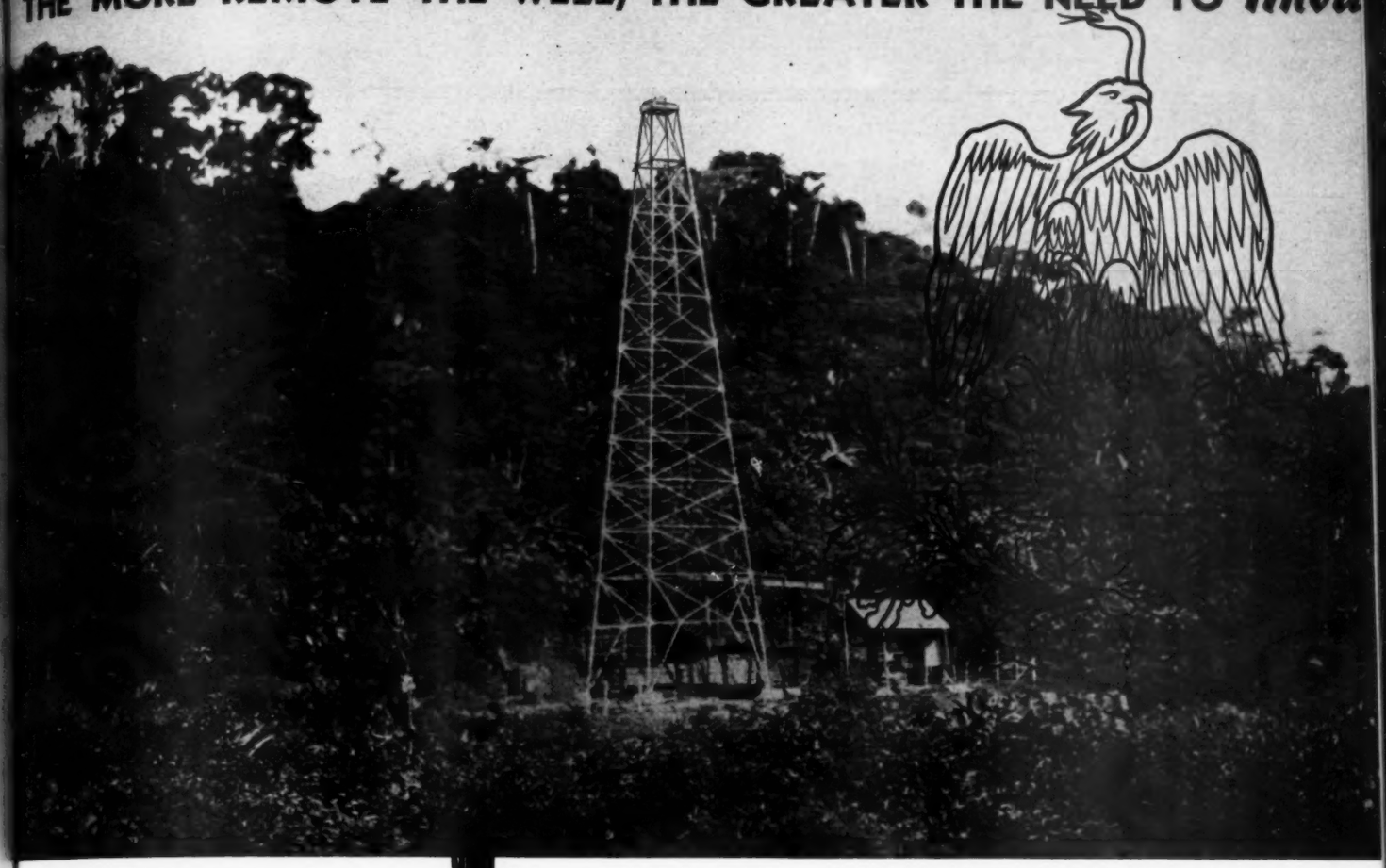

Actual Photo of Operations in the Isthmus of Tehuantepec, Mexic

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"WHY SET CASING BEFORE YOU KNOW?"

THE Petroleum Engineer • MARCH 1938 • VOLUME IX NUMBER 6

A MAGAZINE OF METHODS FOR OPERATING MEN

This Issue Contains

DRILLING AND PRODUCTION

Derrick Structures for Water Locations ... 33
By I. W. Alcorn

Inexpensive Reconditioning of Oil Wells (Part 2) ... 48
By Henry E. Winter

"Closed System" Makes Effective Salt Water Disposal Plant ... 52
By Leo H. Towers

REFINING AND NATURAL GASOLINE MANUFACTURE

Chemical Utilization of Gaseous Hydrocarbons (Part 1) ... 57
By B. Kwal

Remodeling of Cracking Equipment Increases Refinery's Capacity ... 66
By J. C. Albright

Bleaching Clay (Part 7) ... 70
By Rafael Fussteig

New Gasoline Plant Operates on High- and Low-Pressure Gas at Well Pressure ... 82
By Frank H. Love

OIL AND GAS TRANSPORTATION

A Theory of the Corrosion-Time Relationship for Underground Pipes ... 38
By Norman L. Hoff

Improved Operation of Windchargers for Cathodic Protection of Pipe Lines ... 76
By Dave Harrell

GENERAL

Gas Engine Electric Starting and Ignition Systems ... 41
By C. C. Keane

Correct Pulley Diameter for Oil Machinery ... 54
By W. F. Schaphorst

ENGINEERING NEWS OF INTEREST

Final Report on Explosion in New London, Texas, School Building Made by Bureau of Mines ... 37

Foreign Crude Oils Analyzed by Bureau of Mines ... 40

Practical Information on Motor Gasoline Made Public ... 46

New Oil Line Constructed of Unusually Large-Diameter Pipe ... 46

A.P.I. Sees Little Danger of Oil Depletion 64

East Texas an Important Petroleum Production Laboratory ... 74

REGULAR DEPARTMENTS

The Course of Oil ... 17
Highlights in Oildom ... 18 and 20
Latest Activities in the Oil Fields ... 22
Summary of Petroleum Statistics and Field Activities ... 24
Progress of Major Pipe Line Work ... 26
The Month's Activities in Refining ... 28
Running Tour with Men in the Industry 86
Laugh with Barney ... 88
Machinery and Equipment ... 90, 92, 93, 94, 95, 96, 97, and 98
Trade Personals ... 108
Trade Literature ... 108
Book Reviews ... 109
The Petroleum Engineer's Continuous Tables (Installment 10) ... 113

MEETINGS

American Society of Mechanical Engineers—March 23, 24, and 25, Los Angeles, California.

•

American Petroleum Institute, Division of Production, Southwestern District, Spring Meeting—March 24 and 25, Blackstone Hotel, Fort Worth, Texas.

•

California Natural Gasoline Association — April 7, Richfield Building, Los Angeles, California.

•

Petroleum Industry Electrical Association—April 13, 14, and 15, Rice Hotel, Houston, Texas.

•

American Petroleum Institute, Division of Production, Eastern District—April 14 and 15, William Penn Hotel, Pittsburgh, Pennsylvania.

•

American Chemical Society—April 17, 18, 19, 20, and 21, Dallas, Texas.

•

American Petroleum Institute, Pacific Coast District, Division of Production, Spring Meeting—April 19, Biltmore Hotel, Los Angeles.

•

Western Petroleum Refiners Association, Annual Meeting—April 25, 26, and 27, Hot Springs, Arkansas.

•

American Gas Assocation, Natural Gas Department, Annual Meeting—May 9, 10, 11, and 12, New Orleans, Louisiana.

•

Natural Gasoline Association of America, Annual Convention—May 11, 12, and 13, Hotel Tulsa, Tulsa, Oklahoma.

•

International Petroleum Exposition—May 14, 15, 16, 17, 18, 19, 20, and 21, Tulsa, Oklahoma.

•

American Petroleum Institute, Eighth Mid-Year Meeting — May 23, 24, and 25, Wichita, Kansas.

•

Pennsylvania Grade Crude Oil Association and Pennsylvania Natural Gas Men's Association, Seventh Annual Petroleum and Natural Gas Conference—May 27 and 28, Pennsylvania State College, State College, Pennsylvania.

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Seventh Floor Allen Building DALLAS, TEXAS Telephone: 2-4571

C. Morris - - - - *President-General Manager*
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Wallace A. Sawdon - - *Contributing Editor*

PITTSBURGH, PENN.
Roger Motheral
Eastern Representative
230 Beverly Road
Mt. Lebanon
Telephone: Locust 1500

TULSA, OKLAHOMA
T. J. Crowley
Vice-President
310 Thompson Bldg.
Telephone: 3-0623

LOS ANGELES, CALIF.
R. C. Wipperman
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The Course of Oil

By K. C. SCLATER

California Proration Law

Advocates of proration in California are having an uphill fight, despite the fact that an estimate places a majority of oil men as being in favor of a State proration law. It has been said that a recalcitrant minority representing not more than fifteen percent of the independent producers are opposed to the measure. Barely enough votes favoring State control could be rallied at a meeting of operators in Los Angeles on March 4, due, it is asserted, to filibustering tactics of the very small minority comprising the opposition.

Sentiment in favor of a State proration law seems to be increasing. Leading independent oil operators on March 12 joined in a strong recommendation that a State oil control bill be passed at once. A poll of the board of directors of the Oil Producers Agency at a special meeting in Los Angeles showed that of 26 votes cast only one opposed the principle of State control.

Urgent need of action is seen in the fact that California is producing more than 100,000 barrels of oil daily in excess of demand and at the beginning of March had only enough storage for about fifty days at the present rate of production.

Passage of a proration law in California, it is believed, would be a significant factor contributing to economic stability in the petroleum industry.

Oil Metering Conference

A conference on the metering of crude oil and its products will be held next month at the University of Oklahoma. The School of Mechanical Engineering there is coöperating with the Petroleum Division of the American Society of Mechanical Engineers in arranging the program for the conference.

There is a rapidly-growing need for an accurate means of metering crude oil and its products. To meter crude oil as it comes from the well is one particular phase of measurement that presents many difficulties. Much intensive research to overcome these difficulties has been carried on in recent years, both by meter manufacturers and oil company engineers. Though great progress has been made and the use of meters for the measurement of refined products and of crude in pipe line transportation is by no means uncommon, further research and development will likely be necessary before accurate meters will be available that are sufficiently foolproof for general oil field use.

This conference will be a means of reviewing the experiences of oil companies in the use of meters of different types and the problems pertaining to the metering of crude oil and its products. It was with these thoughts primarily in mind that the sub-committee of the Fluid Meters Committee of the American Society of Mechanical Engineers, following a meeting at Tulsa, Oklahoma, in January decided that the scope of its activities include a study of all types of fluid meters that might be used for measuring petroleum products, and the problems involved in metering crude oil.

When meters become generally practicable for the measurement of crude oil at the average well, their wide application is assured. They will aid greatly in maintaining accurate well production records. For this reason, the conference is of especial interest to production officials and engineers and should develop much valuable discussion toward accelerating progress in the metering of crude oil and its products.

Marine Drilling Operations

Offshore drilling operations just getting underway in the Gulf of Mexico usher in an era of oil development that promises to surpass in magnitude any marine drilling projects the industry has seen to date. Many new problems must be faced, for drilling in the open waters of the Gulf of Mexico has many hazards. Derrick structures must be strong enough to withstand severe blows during drilling. This presents no mean task in design. Even after the well is completed, the well connections must be secure against damage. Blowout hazards and the pollution damage that may ensue emphasize the importance and necessity of guarding against failure of any part of the equipment. There are indications that the industry may become the target of certain interests that would invoke legislative measures to prevent oil development in the waters of the Gulf on the grounds that pollution will result and cause untold damage.

There will be no reason to fear pollution provided proper precautions are observed. In fact, the taking of proper precautions is a prerequisite. Companies that engage in open-water drilling in the Gulf of Mexico must comply with Federal Government regulations and have their plans checked and approved by War Department engineers.

Difficulties encountered in the Elwood field in California are a good example of what marine drilling operations entail. Experience in that field, however, will be of only supplementary value to operators in meeting the problems of marine drilling in the Gulf of Mexico. Problems faced there are not quite like those found elsewhere. Petroleum engineers must delve into the intricacies of tidewater action and the effect of high-wind velocity on well structures and well connections.

The dissemination of information gained from experience in the design and use of derrick structures for marine drilling is very desirable. It will aid in effecting economies in the many similar drilling operations that are now being planned. This is the purpose behind the article on derrick structures for open-water drilling appearing in this issue. It is the forerunner of many similar articles designed to record the progress in this important new phase of oil development.

« « HIGHLIGHTS IN OILDOM » »

Oklahoma's Well-Spacing Law Upheld

The state Supreme Court has upheld the constitutionality of Oklahoma's well-spacing law passed in 1935. The law authorizes the Corporation Commission to regulate the spacing of oil and gas wells in the interest of conservation. The court opinion declared that protection of the rights of owners in a common source of oil and gas supply is included in the police power of the state and under the constitution this power may be exercised by regulating the drilling of wells into the common source and distributing the production pro rata among the owners of overlying mineral rights.

The decision was made in a case brought before the court on appeal of Russell B. Patterson, Tulsa operator, who sued the Stanolind Oil and Gas Company and the Amerada Petroleum Corporation to recover $988.68 in royalty payments he declared were due him on an oil and gas lease in the north Wellston area of Lincoln County. The well in question was drilled in the center of a 10-acre tract. Patterson owned the north six and one-fourth acres of the tract and the well was located on his part of the lease. Patterson claimed $988.68 by virtue of an undivided one-sixteenth interest in the minerals under his tract. The defendants pointed out that the north Wellston area is governed by a 10-acre well-spacing order and that under the law Patterson was entitled to only $824.32, or his proportionate part of the royalty from his interest in the ten acres.

The complainant contended he was being deprived of his property without due process of law, but the court held that in protecting from sporadic drilling the common source of supply, which extends beneath both parts of the tract, the law will prolong the benefits for the complainant and provide a greater ultimate gain than if the number of wells drilled was unlimited. The court declared that the property involved had not been confiscated, but that its use merely had been restricted without violation of the due process clause. The police power of the state may be used to prevent destruction of common source of supply, the court said.

The well-spacing section of the statute in question obviously was intended to prevent waste by limiting the number of wells to effect the greatest ultimate recovery, the court held.

Oklahoma oil men view the Supreme Court's decision as being one of the most important in years. The decision, they said, will eliminate town lot drilling in the state, force a trend toward unitization of properties, and insure orderly development and greater conservation of reservoir energy.

●

New Field in Germany Shows Great Promise

The results of drilling near Bergedorf on the Elbe River, Germany, have caused geologists in charge to predict that the field may replace the Nienhagen field in Hannover as Germany's largest producer of crude oil. Prior to the World War a gas well existed near Bergedorf, but subsequently it was abandoned and apparently no serious consideration was given to the possibility that oil might be found there until recent months. Oil was found at Bergedorf in October, 1937, at a depth of about 2300 feet. The flow was not great and the well was capped pending further exploration. On December 18, 1937, Well No. 3 was brought in at a depth of approximately 2280 feet. Production of this well is estimated from 700 to 1050 bbl. per day, about one-tenth of the entire present German production.

Gas-Oil Ratio Survey Ordered For West Texas

The Railroad Commission has ordered quarterly gas-oil ratio surveys in 36 West Texas fields and ratio limits in six other fields have been readjusted.

The following gas-oil ratios have been prescribed: North Cowden field, 3500 cu. ft. per bbl.; Goldsmith field, 5000 cu. ft. per bbl.; Kermit field, 3000 cu. ft. per bbl.; Keystone field, 8000 cu. ft. per bbl.; North Ward field, 5000 cu. ft. per bbl.; Fuhrman field, 5000 cu. ft. per bbl.; and South Ward field, 5000 cu. ft. per barrel.

Gas-oil ratio surveys and reports on oil wells having a ratio in excess of 2000 cu. ft. per bbl. were ordered for the following fields for quarters beginning on dates given:

Winkler County, March 31: Bashara, Eaves, Emperor, Halley, Henderson, Kermit, Keystone, Scharbauer, and Sealey.

Ward County, April 30: Estes, Monroe, North Ward, South Ward, and Wilson.

Gaines, Yoakum, Cochran, Andrews, and Hockley counties, May 31: Bennett, Duggan, Fuhrman, Means, Seminole, and Wasson.

Ector County, June 30: North Cowden, South Cowden, Foster, Penwell, Goldsmith, and Harper.

Loving and Pecos counties, July 31: Mason, Netterville, Pecos Valley, Wheat, and Payton.

Crane and Upton counties, August 31: Gulf McElroy, Jordan (in Crane and Ector), Sand Hills, Sand Hills Ordovician, and Waddell.

●

Government Plans Increased Production Of Helium

According to a recent statement by an official of the United States Department of the Interior, the government plans the purchase of helium gas plants at Dexter, Kansas, and Thatcher, Colorado, and the increase of their production. Definite plans for the development of the leases have not been made and will not be until Congress has provided funds for the purchase of the two plants, and market demand for helium during the coming year has been determined.

A board of appraisers, acting under the helium act passed by the recent session of Congress giving the government a monopoly on the helium supply in the United States, set a value on the two plants, now the property of the Girdler Corporation, Louisville, Kentucky. The Girdler Corporation has agreed to sell at the valuation of $537,975.

●

State Controls Waste Disposal In Oil Fields

Rules, approved and signed by Governor Marland on February 23 and effective March 10, give the state Planning and Resources Board full control over the disposal of waste oil, brine, and acid from Oklahoma oil wells and mines. The rules provide that the board's approval must be obtained before any harmful waste from oil fields and mines is dumped into any stream, lake, or subsurface watercourse. In newly-discovered fields the board may approve plans for temporary retention of the waste in reservoirs until permanent disposal methods are approved.

R. L. Hodges, pollution engineer for the board's water resources division, states that nine disposal projects already have been approved by the board. Several are in operation. In most of the systems waste is gathered by pipe lines and pumped into deep disposal wells.

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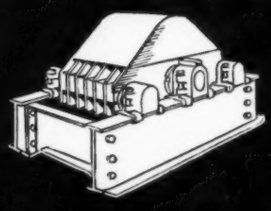

1 Easy to Install

American Bearings are very easy to install. A complete bearing is composed of three separate parts—the inner race or sleeve, outer race or casing, and cage. Adjusting shims are not needed; neither are threaded housing closures. Special designs are unnecessary.

2 Never Need Adjustment

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Straight-line construction reduces power loss to the minimum that it is possible for design to reach. The superior grade of steel used makes this advantage lasting.

6 The Oil-Field Bearing

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Thirty oil-field manufacturers have made American Heavy Duty Roller Bearings standard for the heavier types of Crown Blocks, Traveling Blocks, Draw-Works, Rotary Drives, Clutch Pulleys, Pumping Units, Swivels and other drilling equipment.

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New Casing Program for Rodessa, Texas

The Texas Railroad Commission has provided a new casing program for the Texas side of the Rodessa field. The new ruling provides that all wells drilled hereafter shall have at least two strings of pipe set in accordance with the following program:

A minimum of 1000 ft. of new surface casing shall be set and cemented with sufficient cement to fill the annular space back of the casing to the surface of the ground. Cementing shall be by the pump and plug method, and the cement must be allowed to stand for 24 hours before the plug is drilled. Before drilling the plug the casing must be tested by pump pressure in the presence of a railroad commission agent or offset operator.

The producing string of casing shall consist of new casing having a mill test of at least 2100 lb. per sq. in., and shall be set at a point not higher than the top of the producing horizon, using a sufficient amount of cement to fill the annular space back of the casing to a distance up the hole at least 20 ft. above the base of the hard chalk above the Blossom Sand.

The new program replaces the three-string casing plan that has been in effect.

●

Government Subsidies For Oil Tankers

The United States Congress has authorized the Maritime Commission to institute a program of subsidies to shipowners and oil companies in providing vessels that can be utilized as naval auxiliaries in event of war. Proposals have been made to several oil companies that they construct faster oil tankers than ordinarily would be needed, the Maritime Commission to pay the difference in cost. The payment will be made outright and the oil companies agree to maintain the tankers in operating condition for a period of 20 years. In event of an emergency they can be requisitioned by the government, the owners being compensated for their share of the vessel at a depreciated value.

The Standard Oil Company of New Jersey has accepted the Maritime Commission's proposal and has placed orders for 12 16,300-ton tankers capable of 16½ knots loaded and 18 knots light.

●

New California Bill Governing Tideland Drilling

A bill has been introduced before the special session of the California Legislature, which, if passed, will change completely existing laws governing the disposition of tideland oil lands owned by the state in southern California. The bill is sponsored by Governor Merriam and provides for a commission empowered to ask for competitive bids. If the bids are considered too low the state shall have the right to drill and operate the properties.

●

Rodessa, Louisiana, Gas Must Be Metered

All gas produced from wells on the Louisiana side of the Rodessa field must be measured continuously by meters, according to a recent order of the Louisiana Conservation Commissioner, William G. Rankin. The order became effective March 1st. The meters shall be of a type approved by the commissioner and meter records must be sent him each month. A meter record for each lease must be provided, and no operator is exempt from the provisions of the ruling.

Pennsylvania Investigation Halted by Injunction

The committee authorized by the 1937 legislature to investigate the oil industry in Pennsylvania has been halted in its proceedings by a temporary injunction. Hearings of the committee have been postponed until the Dauphin County Court issues its decision on the order restraining the commission from examining the books of the Petrol Corporation, Philadelphia. The court also has issued an order restraining the committee from contracting further debts until the constitutionality of the investigation has been determined.

The commission, which is studying the necessity for statewide regulation of petroleum, has issued 39,500 questionnaires to producers, refiners, distributors, holding companies, pipe line companies, and filling stations, in addition to holding several hearings, in an effort to determine the problems of the industry.

●

Surveys on Gaspe' Peninsula, Canada

Officials of the Quebec, Canada, Provincial Department of Mines report that geologists are studying subsurface conditions of the Gaspé Peninsula to determine the possibility of oil deposits. The surveys are being financed by private interests but the Department of Mines and the Provincial Government are interested indirectly.

●

Reduction in Pennsylvania Crude Prices

The South Penn Oil Company on March 7 announced reductions of 15 cents to 17 cents on Pennsylvania crude oil, as follows: Bradford-Allegheny, $2.05; Southwest, $1.71; Eureka, $1.65; and Buckeye, $1.55.

●

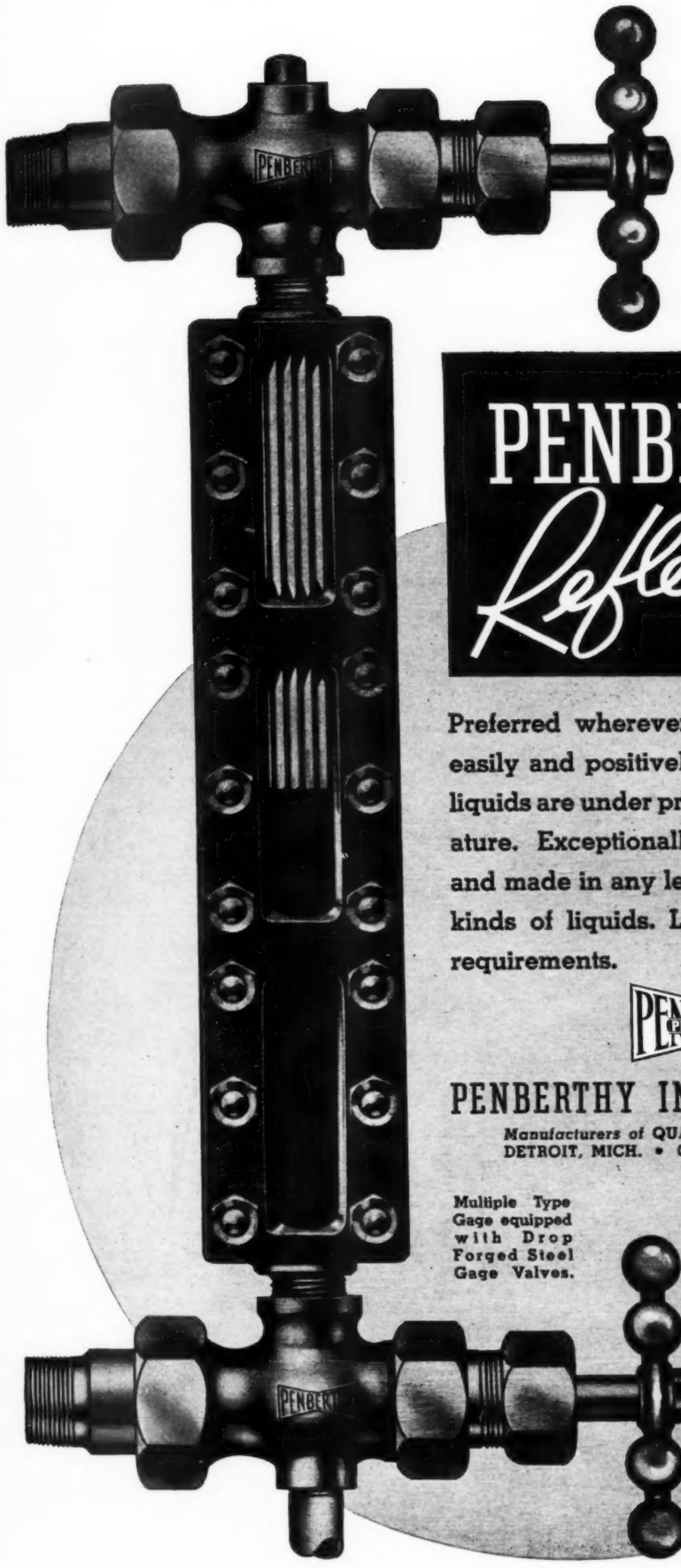
N.G.A.A. Revises Testing Methods

The Natural Gasoline Association of American recently revised its standard methods of sampling and testing for natural gasoline and has issued a new specifications card in which these revisions have been incorporated.

The revisions are in the nature of modernization rather than fundamental changes although one new standard was added, this being a method for sampling procedure and specification of definite requirements for sampling containers. The new standard is noted on the new specifications card as, "Same as A.P.I. Code 50-B." The latter was developed largely through coöperative efforts with the California Natural Gasoline Association, and the combined ideas correlated in committees of the American Petroleum Institute.

With reference to standard test methods, the association has done considerable work in recent years with these standards, revising and modernizing them to eliminate optional clauses and otherwise to improve technique to obtain more duplicable results. Through coöperation with the American Society for Testing Materials, these revisions have been incorported in the corresponding methods of that Society and the number references to these methods have been changed to the new designations of the revised A.S.T.M. standards. A slightly extended abridged volume-correction table of the A.S.T.M. also was adopted.

Copies of the new N.G.A.A. Specifications card can be obtained from the offices of the association, 819 Wright Building, Tulsa, Oklahoma.



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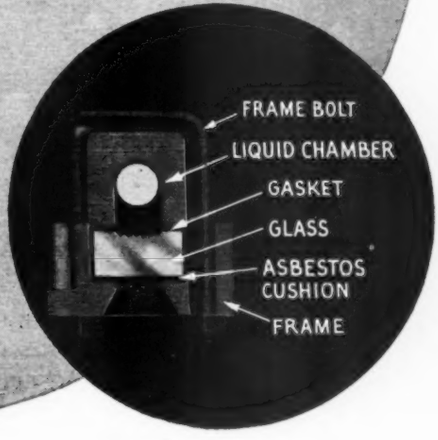

Latest Activities In The Oil Fields

NEAR Tiffin, Ohio, a well drilled by A. J. West and Sun Oil Company found oil at a depth of 2046 ft., in a sand about 600 ft. below the Trenton sand, from which the old wells are producing. The oil is of somewhat higher grade than the oil from the Trenton, and the Sun company is expected to drill several more wells on its block of leases. Other companies show little interest in the development, possibly because of the large extent of the Sun company holdings in the area.

●

In the Fitts field, Oklahoma, a well drilled by the Magnolia Petroleum Company as a salt water disposal well, supposedly southeast of the fault, was acidized and produced oil at the rate of 2736 bbl. per day, accompanied by 3,200,000 cu. ft. of gas. The well is the Augustanna No. 1, in SWC NE 26-2-7e. Production is from the Hunton limestone at a depth of 3935 to 4070 feet.

●

Interest in the Tool field of Henderson County, Texas, was stimulated by the completion of the second well as a large producer, the potential capacity of which is variously estimated at 2500 to 10,000 bbl. per day. Lack of storage facilities prevents an accurate gauge. The well is the Hines and Hancock No. 1 A. R. Dillard, south offset to the discovery well, Hunt, DeArman, and MacMillan No. 1 Dillard, which is making its allowable of 100 bbl. per day. The new well is reported to have drilled 11 ft. of Woodbine sand from 3065 to 3076 feet. The gravity of the oil is between 46 and 47 degrees.

●

A new gas field 12 miles southeast of Wellsville, New York, was opened by the Belmont Quadrangle Drilling Corporation No. 1 Hilligass. Initial open flow was 11,500,000 cu. ft. and pressure was 1975 pounds. Three ft. of Oriskany sand was drilled between 4822 and 4825 feet.

The Sac and Fox pool, east-central Lincoln County, Oklahoma, was extended two miles westward by the completion of H. F. Wilcox Oil and Gas Company No. 1 Royer. The well was drilled in SEC NE 18-14-6e and found the Prue sand between 3245 and 3372 ft., more than 100 ft. of finely saturated core being recovered.

●

The Slaughter area, southwestern Hockley County, Texas, has been extended two miles northward. Sid Richardson No. 1 Slaughter Estate, in labour 59, league 39, M. C. S. L. Survey, produced at the rate of 429 bbl. per day through ½-in. choke on Railroad Commission gauge. A 380-qt. shot was placed between 4895 and 4989 feet. Total depth of the well is 4994 feet.

●

The second well to produce oil from the Permian in Arkansas is the Marine Oil Company No. 4 Justiss, in the center of lot 7, NW 18-18-17. Casing was set at 7719 ft. and perforated from 7650-58 feet. The well flowed at the rate of 30 bbl. of 38-deg. oil per hour through ¼-in. tubing choke. This well is in the Schuler field, Union County.

●

Shell Petroleum Corporation's No. 1-C Baumgart flowed at the rate of 434 bbl. of oil per day through 2-in. tubing and also produced 744,000 cu. ft. of gas upon completion. The well was shot with 600 qt. of nitroglycerine at 4810 to 5018 ft. and treated with 5000 gal. of acid. Total depth of the well is 5018 feet. The well was drilled in Section 866, Block D, John H. Gibson Survey, Yoakum County, Texas, and extends the Denver area a mile and a half southeastward.

●

Plymouth Oil Company No. 1 Brigham, discovery well in East White Point field, San Patricio County, Texas, produced 54 bbl. of 38.3-deg. oil in six hours through 9/64-in. choke by official gauge. Casing pressure was 1100 pounds. The producing zone was drilled between 5661 and 5665 feet.

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New Mexico	.78-1.08
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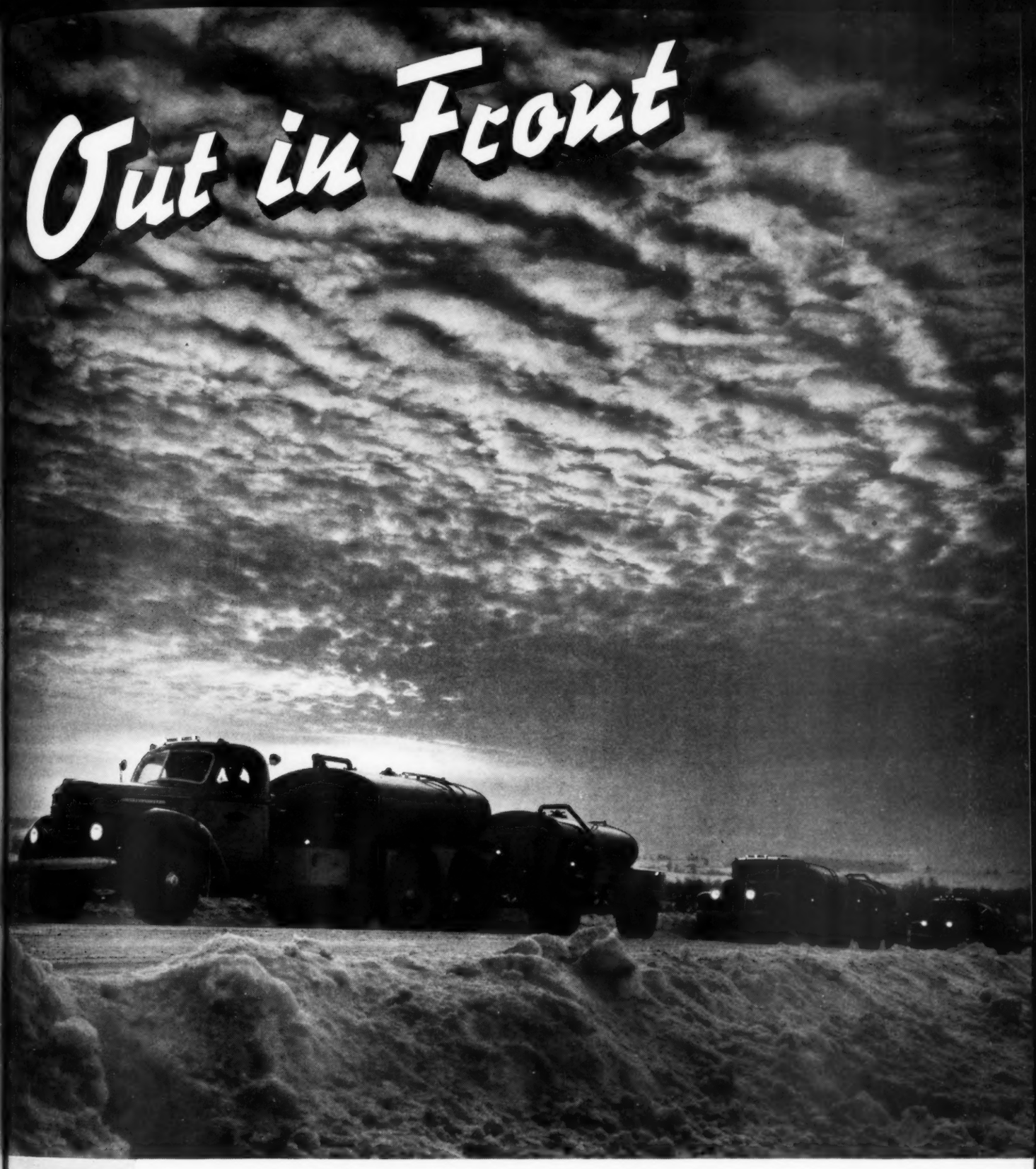
Panhandle	.91-1.08
West Texas	.78-1.08
Gulf Coast	.95-1.41
Darst Creek	1.09
East Texas	1.35
Talco	.73
Kansas	.98-1.30
Oklahoma	.98-1.30
Arkansas	.90
Louisiana	
Rodessa	$ .91-1.25
Gulf Coast	.84-1.41
North Louisiana	.90-1.22
Illinois	1.35
Kentucky	1.40
Indiana	1.12
Ohio	
Lima	1.25
Michigan	1.27
Pennsylvania	
Bradford	2.05
Southwest	1.71
Eureka	1.65
Buckeye	1.55
Corning	1.27
West Virginia	1.67
Canada	2.10-2.17

DAILY AVERAGE CRUDE OIL PRODUCTION

Data Supplied by A.P.I.

(Figures in Barrels)

	B. of M. Dept. of Int. Calculations (March)	Week Ended March 5, 1938	Week Ended January 29, 1938	Week Ended March 6, 1937
Oklahoma	547,700	522,450	553,900	578,150
Kansas	176,700	166,900	187,050	187,350
Panhandle Texas		67,300	74,200	68,700
North Texas		65,150	63,000	67,250
West Central Texas		26,350	31,350	31,850
West Texas		180,950	175,600	197,750
East Central Texas		90,550	79,250	109,150
East Texas		426,500	423,250	452,900
Southwest Texas		218,850	206,900	225,150
Coastal Texas		194,100	184,250	197,550
TOTAL TEXAS	1,344,900	1,269,750	1,237,800	1,350,300
North Louisiana		80,000	78,450	71,150
Coastal Louisiana		176,750	176,200	175,200
TOTAL LA.	239,400	256,750	254,650	246,350
Arkansas	38,200	49,800	42,450	27,150
Eastern	129,200	134,050	132,750	116,250
Michigan	51,600	50,200	48,250	34,050
Wyoming	46,400	47,500	50,800	52,550
Montana	13,300	12,100	13,450	15,700
Colorado	4,500	4,350	4,200	4,400
New Mexico	105,100	105,050	107,150	100,450
TOTAL EAST OF CALIF.	2,697,000	2,618,900	2,632,450	2,712,700
California	694,600	720,800	725,200	586,100
TOTAL U. S.	3,391,600	3,339,700	3,357,650	3,298,800



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But service—no matter how superior—is of no value until it is rendered. Dowell is well aware of this and believes in giving service *fast*. Production resumed a day earlier means an extra day's profit for the producer. Let Dowell demonstrate its definition of faster service. Treating stations in all principal lime areas.

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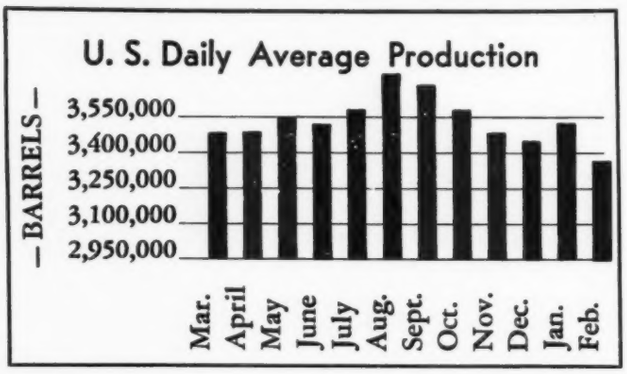
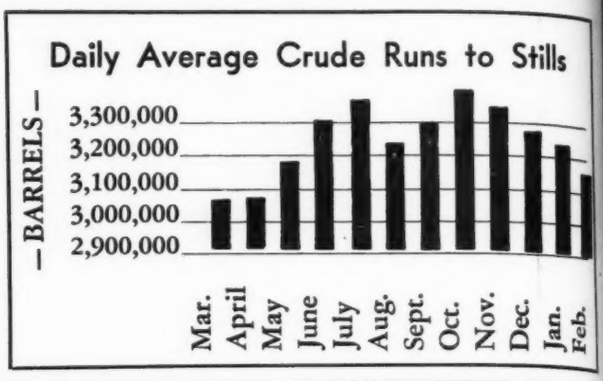
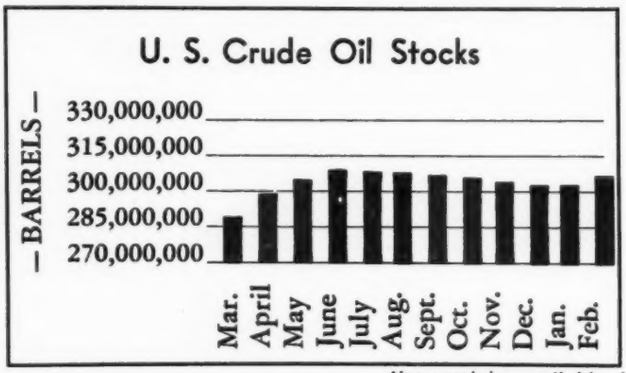
Executive Office: MIDLAND, MICHIGAN • *General Office:* KENNEDY BUILDING, TULSA, OKLAHOMA

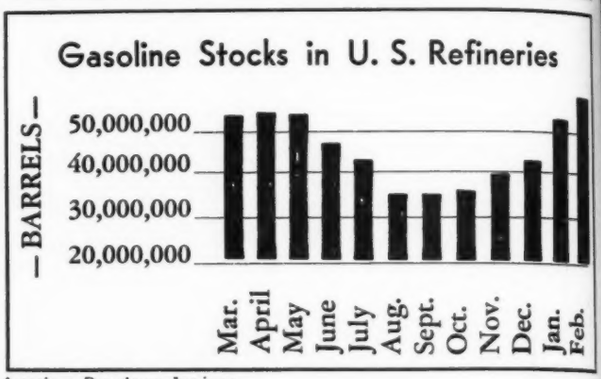
IL AND GAS WELL CHEMICAL SERVICE

Summary of Petroleum Statistics and Field Activities









Above statistics supplied by the American Petroleum Institute.

Summarized Operations in Active Fields for February, 1938

Fields	Completions	Producers	Rigs	Drilling Wells	Depth of Production	No. Casing Strings	Gravity of Oil	Type of Tool Used
Texas								
East Texas	187	180	41	89	3500-3700	2	40	Rotary
Duval County	44	34	7	30	1554-2900	2	22	Rotary
Ector County	52	51	13	55	3675-4377	2 and 3	32-36	Rot.-Cab.
Panhandle	60	52	55	169	1700-3900	2	40	Rotary
Refugio County	9	8	2	10	4900-5900	2	38	Rotary
Nueces County	21	16	10	38	3922-5878	2 or 3	21-54	Rotary
Winkler County	26	26	7	22	2850-3450	2 and 3	30-38	Rot.-Cab.
Talco Field	10	9	2	9	4280-4361	2	16-24	Rotary
K. M. A. Field	39	35	65	109	3730-3935	2	42-43	Rot.-Cab.
Oklahoma								
Oklahoma City	4	4	2	10	6450-6682	3	39	Rotary
Fitts Pool	27	24	3	12	1800-4488	2 or 3	38	Rotary
Kansas								
Russell County	23	22	7	42	2926-3435	2 and 5	32-37	Rot.-Cab.
Rice County	10	7	6	25	3222-4085	2 and 5	42-48	Rot.-Cab.
Barton County	22	16	8	32	3290-3518	2	39-42	Rot.-Cab.
Louisiana-Texas-Arkansas								
Rodessa	14	14	6	33	5950-6450	3	39	Rotary
Illinois								
Central Illinois	45	33	28	100	2950-4100	2	36-38	Rot.-Cab.
New Mexico								
Lea County	23	21	15	103	3150-4030	3	30-34	Rot.-Cab.
California								
Kettleman Hills	3	3	2	12	8300-8730	3 or 4	40	Rotary
Wilmington	25	25	19	30	3500-4000	2 and 3	18-20	Rotary

Field Activities by States for February, 1938

State	Completions		Producers		Locations		Rigs		Drilling Wells		Production, 1937 (In Barrels)
	February	January	February	January	February	January	February	January	February	January	
Arkansas	15	18	11	17	20	22	20	16	32	31	12,088,341
California	95	90	75	71	82	133	105	107	254	259	238,587,663
Colorado	....	2	....	0	....	....	2	1	26	30	1,532,893
Illinois	41	57	30	40	....	19	110	*115	32	40	7,376,022
Indiana	7	....	1	....	....	....	2	3	33	34	820,000
Kansas	127	170	77	130	144	175	52	48	307	331	70,542,000
Kentucky	50	46	40	29	....	....	10	13	78	84	5,500,000
Louisiana	69	115	47	74	157	92	60	39	229	199	90,501,068
Michigan	65	54	43	40	38	58	32	43	138	159	16,254,181
Mississippi	3	....	0	....	....	....	2	8	7	12	Gas Prod.
Montana	2	3	2	1	....	....	3	2	45	49	5,775,000
New Mexico	33	44	28	41	....	....	13	15	150	155	38 642 184
New York	8	3	7	3	....	....	....	....	....	....	5,466,200
Ohio	70	80	52	53	....	....	49	53	161	192	3 547,600
Oklahoma	181	172	128	129	191	185	45	52	333	352	225 402,731
Pennsylvania	....	....	....	....	....	....	....	....	....	....	19.154,400
Texas	963	996	769	801	1217	1152	354	352	1292	1399	506.891.233
West Virginia	65	81	58	66	....	....	30	33	151	168	3.833.000
Wyoming	4	7	4	7	....	....	8	10	77	78	19,402,121
Total	1798	1938	1372	1502	1849	1836	897	910	3345	3572	1,271,316,637

*Includes 79 rigs standing and 36 rigging up.

16 Months Continuous Service with HYPER

AND NOT A SINGLE CHAIN BREAK!

● 17,900 feet of hole under normal drilling conditions would not be unusual service for Link-Belt 3-Bar HYPER Chain . . . but this amount of footage in hard rock formation is a different story. Throw in two difficult fishing jobs, which prolonged the total period of continuous service to 16 months, and you have exceptional ton-mileage.

This is the record of Link-Belt SS-124 3-Bar HYPER Chain (170,000 pounds ultimate breaking strength) on this Washington County, Texas, wildcat development, including an 8,400-foot hole, a 5,500-foot hole, and now drilling ahead near 4,000 feet on the job pictured here.

During this period of 16 months continuous service *there has not been a single chain break.*

This is just another instance of the unusually satisfactory performance of Link-Belt Oil Country Chains.

In addition to rotary drilling chains, Link-Belt oil country products include: Rotary Mud Vibrating Screens, Silent Chain Drives, Roller Chain Drives, Flexible Couplings, Speed Reducers, Pillow Blocks, Clutches, Take-ups, Collars, and other products.

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LINK-BELT CHAINS

Progress of Major Pipe Line Work

THE Panhandle Eastern Pipe Line Company plans the expansion of its system, according to recent reports. At present right-of-way is being purchased in southern Franklin County, Kansas. It is announced that a second 24-in. line will be laid to parallel the existing one. The line is to be constructed this summer.

Panhandle Eastern also is giving consideration to extension of its line into St. Louis, Missouri, to supply that city with natural gas, it has been revealed. The company already has a line to Bowling Green, Missouri, 65 miles from St. Louis. The latter city at the present time is supplied natural gas from the Monroe field, Louisiana, transported through a 22-in. line by the Mississippi Valley Fuel Company.

●

The Texas-New Mexico Pipe Line Company is reported to have purchased right-of-way for a pipe line into the Vacuum field in Lea County, New Mexico. The outlet will be an 8-in. line extending to the Texas-New Mexico's Lunch station 18 miles to the southwest, it is stated. At the present time the Vacuum field does not have a pipe line outlet and production is being stored in an 80,000-bbl. storage tank at the north end of the field, which is owned by the Magnolia Petroleum Company. A pipe line connection would stimulate drilling activity in the area, it is believed, especially on the east side where numerous scattered small tracts are held by major and independent companies.

●

The Standard Oil Company of Louisiana is obtaining right-of-way to lay a 4-in. pipe line from its deep production in the Cotton Valley field, Louisiana, to its Willer tank farm ten miles east of the field.

●

The Producers' Natural Gas Pipeline Company, incorporated by R. A. Whitehead, Lansing, Michigan; Roy T. Ide, Guy M. Obenhauer, and Edward J. Lieber, all of Detroit, Michigan; and Paul B. Whitney, Grand Rapids, Michigan, has asked approval of the Michigan Public Utilities Commission to construct and operate natural gas transmission lines serving ten cities in the state. Gas supply would be obtained from the Mecosta, Isabella, Montcalm, Gratiot, Shiawassee, Livingston, Wayne, Allegan, and Clinton fields, and the line would be laid to serve the following towns and cities: Owosso, Flint, Pontiac, Greenville, Belding, Battle Creek, Kalamazoo, Jackson, and Ann Arbor. Later the company proposes to supply Monroe, Adrian, Hillsdale, Coldwater, Sturgis, Benton Harbor, and St. Joseph.

●

J. H. McLeod, president of the Royalite Oil Company, announces his company will increase the capacity of its pipe lines between Turner Valley and Calgary, Ontario, Canada, to 24,000 bbl. per day by a construction program involving the laying of several loops.

●

The Continental Pipe Line Company will construct a 14-mile combination 4-in. and 6-in. pipe line to the Ainsworth pool of Barton County, and the Trapp pool, northern Barton and southern Russell counties, Kansas. Right-of-way already has been purchased and the contract for laying the line let to the Osage Construction Company of Great Bend, Kansas. There will be ten miles of 6-in. and four miles of 4-in. pipe laid. The company's main line station in the Ainsworth field will pump the oil.

●

A 6-in. gas line is to be laid from the Lloydminster field, Saskatchewan, Canada, to the town of North Battleford by C. H. Withers, it has been announced. A total of 85 miles of pipe will be laid, including the main transportation line and the distribution system.

●

The Phillips Petroleum Company has purchased from the Barnsdall Refining Corporation the latter's 48-mile, 6-in. pipe line from the Seminole field, Oklahoma, to the Barnsdall refinery at Okmulgee, now shut down. Phillips also has a refinery at Okmulgee and its own 4-in. line from Seminole is being taken up and the pipe will be laid elsewhere.

●

The Bell Oil and Gas Company has purchased from the Continental Oil Company its gathering system in the Burkburnett area of Texas, and the company's main line from that area to Wichita Falls. The purchased line will be tied into the Bell Oil and Gas Company's existing system, which extends from North Texas to the company's refinery at Grandfield, Oklahoma.

●

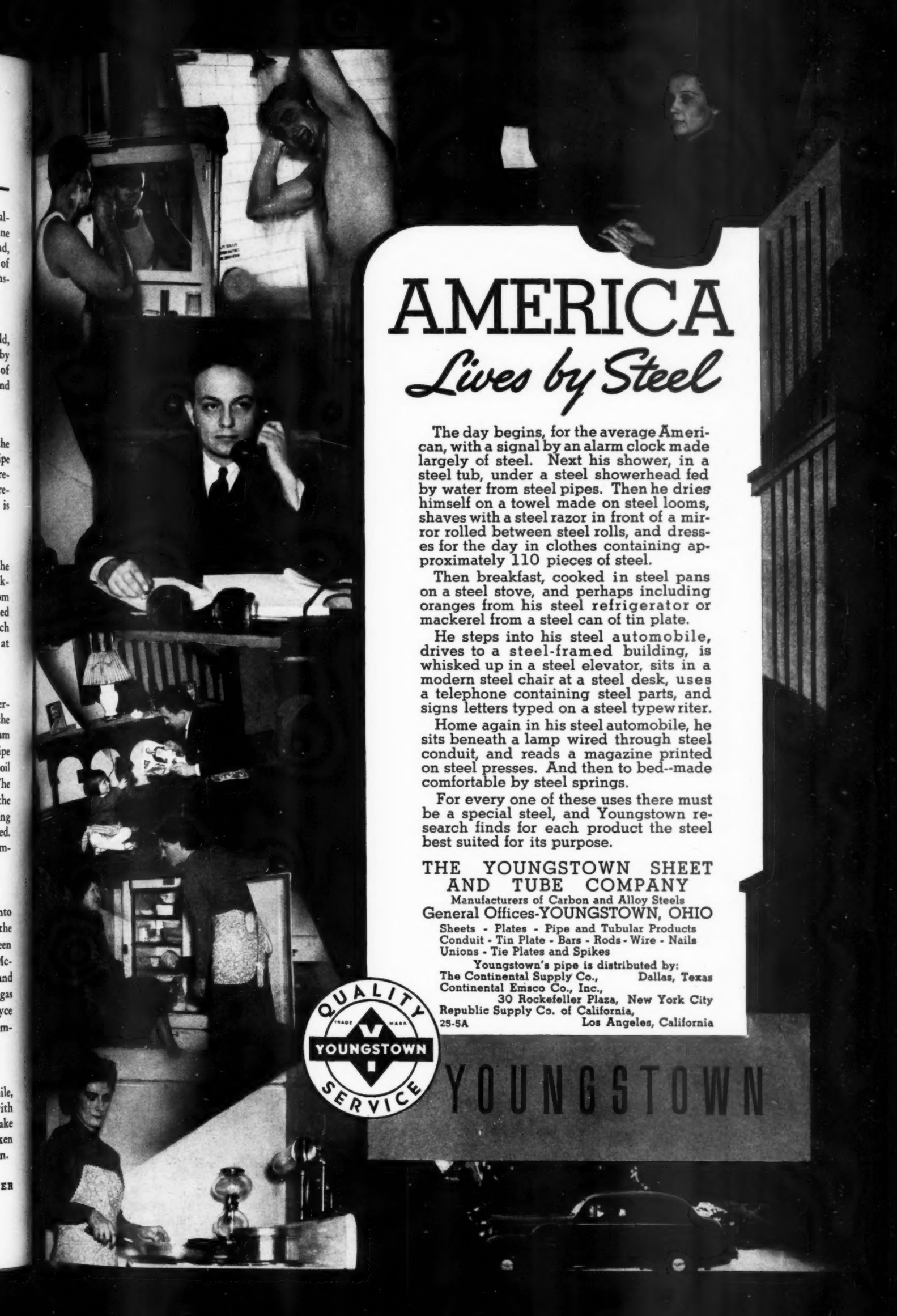
The Southern Phillips Corporation has been granted a permit to operate in Texas. This company is a subsidiary of the Southern Minerals Corporation and the Phillips Petroleum Company, which jointly also have formed the Southern Pipe Line Corporation to gather, transport, and market crude oil from the Turkey Creek field in Nueces County, Texas. The company will lay six and one-half miles of pipe line from the field to its deep water terminal at Corpus Christi. Gathering lines and storage tanks also will be constructed, it is stated. Pittsburgh, Pennsylvania, is the home office of the new company, the Texas office being at Corpus Christi.

●

An 8-mile pipe line has been completed from the Santo Domingo gas field in southern Starr County, Texas, to the Sam Fordyce field, southwestern Hidalgo County, it has been announced by officials of the Hidalgo Gas Company of McAllen. Gas is being taken from No. 3 Clopton of Roos and Bennett, discovery well in the Santo Domingo field. The gas is to be used for flowing producing wells in the Sam Fordyce field and a portion of it also may be turned into the company's industrial line from the Sam Fordyce field.

●

The Lone Star Gas Company has completed an 18-mile, 18-in. gas line from the Buffalo field, Texas, to connect with the company's 12-in. line that extends from the Long Lake field to towns and cities in Central Texas. Gas is being taken from three wells owned by the Shell Petroleum Corporation.



AMERICA
Lives by Steel

The day begins, for the average American, with a signal by an alarm clock made largely of steel. Next his shower, in a steel tub, under a steel showerhead fed by water from steel pipes. Then he dries himself on a towel made on steel looms, shaves with a steel razor in front of a mirror rolled between steel rolls, and dresses for the day in clothes containing approximately 110 pieces of steel.

Then breakfast, cooked in steel pans on a steel stove, and perhaps including oranges from his steel refrigerator or mackerel from a steel can of tin plate.

He steps into his steel automobile, drives to a steel-framed building, is whisked up in a steel elevator, sits in a modern steel chair at a steel desk, uses a telephone containing steel parts, and signs letters typed on a steel typewriter.

Home again in his steel automobile, he sits beneath a lamp wired through steel conduit, and reads a magazine printed on steel presses. And then to bed--made comfortable by steel springs.

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YOUNGSTOWN

The Month's Activities in Refining

Percent Refining Capacity Operated

Western Division, 76.7 Percent **Central Division, 73.0 Percent** **Eastern Division, 78.7 Percent**

CONSTRUCTION of a $22,500,000 refinery in Dublin, Ireland, by the Irish National Refineries, Ltd., now six months under way, will be completed by February or March, 1939, according to J. W. Lane, Dublin attorney and a director of the company, who is in charge of local arrangements pertaining to the erection of the plant. The refinery is being financed largely by American capital, supplemented by British and Irish money. Lane says the output of the plant will be sufficient to supply Ireland's needs, and a considerable volume for export. The crude oil supply will be obtained from the United States.

A subsidiary of the Irish National Refineries, Ltd., will have charge of the transportation of the raw material and refined products. Seven tankers are now being constructed in Germany for this purpose.

●

A 12,000,000-cu. ft. natural gasoline plant has been placed in operation in the Foster field, Ector County, Texas, by the Barnsdall Oil Corporation. The finished product is transported three miles by pipe line to the Texas and Pacific Railroad where it is loaded into tank cars for shipment.

●

The Airlane Petroleum Corporation of San Francisco, California, has completed the remodeling of the old Seager refinery at Oildale, California, to manufacture lubricating oil. The capacity of the plant is 500 bbl. per day. The Seager plant was badly damaged by fire two years ago, following which it was taken over by the Airlane Petroleum Corporation.

●

According to C. H. Lebow of Los Angeles, California, and Wichita, Kansas, ten independent oil producers in the Bemis field, Ellis County, Kansas, plan to construct a 6000-bbl. refinery. Further details of the plan are being withheld until the Kansas Corporation Commission has acted upon an application for sufficient allowable to operate the refinery.

The capacity of the natural gasoline plant of the Warren Petroleum Corporation in the Monument field, New Mexico, will be increased by 30,000,000 cu. ft. per day, it has been announced. At present the plant is manufacturing 50,000 gal. of gasoline per day. The plant's capacity for manufacturing butane also will be increased by the installation of distillation equipment.

●

A 750-bbl. refinery has been completed at Princeton, Louisiana, by Co-Service Oils, Inc., of which Douglas MacDonald is president. The plant is manufacturing lubricating oil, blown asphalt, and greases. A skimming plant is being constructed and will be placed in operation about April 1st.

●

The Portex Oil and Gas Company has begun construction of an absorption-type natural gasoline plant in the Joaquin gas-distillate field of Shelby County, Texas. The company owns three gas-distillate wells in the area.

●

Sunray Oil Company and Phillips Petroleum Company will start immediate construction of a jointly-owned natural gasoline plant in the K.M.A. field near Wichita Falls, Texas, it has been announced by C. H. Wright, president of Sunray. The plant will be capable of handling all of the gas in its vicinity and will be situated on Sunray's Mangold lease in the southwest extension of the pool proper, it is stated.

Both Sunray and Phillips have large holdings to be served by the plant. In addition, contracts have been signed with several independent producers and major companies to process their gas.

●

The Standard Oil Company of New Jersey has awarded a contract to The Girdler Corporation of Louisville, Kentucky, covering the construction of a Girbotol plant for the removal and recovery of hydrogen sulphide from refinery gases at Bayway, New Jersey. The plant will be completed early this summer.

Crude Runs to Stills, Gasoline and Gas and Fuel Oil Stocks
Week Ended March 5, 1938

A.P.I. Figures
(Figures in Barrels of 42 Gal. Each)

DISTRICT	Percent Potential Capacity Reporting	Daily Avg. Crude Runs to Stills	Percent Operated of Total Capacity Reporting	Total Motor Fuel Stocks Thousands of Bbl.	Gas and Fuel Oil Stocks Thousands of Bbl.
East Coast	100.0	561,000	74.9	21,970	9,778
Appalachian	88.4	103,000	79.8	3,767	1,279
Ind., Ill., Ky.	92.4	398,000	81.4	15,550	6,848
Okla., Kans., Mo.	84.7	200,000	67.9	8,195	3,461
Inland Texas	56.6	128,000	63.7	2,831	1,583
Texas Gulf	95.7	684,000	85.8	13,599	9,057
La. Gulf	96.6	132,000	78.6	2,521	3,216
No. La.-Ark.	63.7	40,000	69.0	491	529
Rocky Mt.	69.7	49,000	79.0	2,313	745
California	90.9	555,000	74.4	15,954	83,385
Reported	89.0	2,850,000	77.0	87,191	119,881
Est'd Unreported		280,000		4,960	2,590
*EST'D TOTAL U.S. Mar. 5, '38		3,130,000		92,151	122,471
*EST'D TOTAL U.S. Feb. 26, '38		3,170,000		90,719	†122,430
U.S. B. of M. *Mar. 5, 1937		**3,045,000		78,935	98,198

*Estimated Bureau of Mines' basis.
**March, 1937, daily average.
†Revised due to transfer of 1,472,000 bbl. from stocks of unfinished oils to stocks of gas oil and distillates in California.

THE Petroleum Engineer

MARCH, 1938

Derrick Structures for Water Locations

By I. W. ALCORN
Division Production Engineer
The Pure Oil Company, Houston

Oil development operations in open water in the Gulf of Mexico, off the Louisiana and Texas coast, confront certain inherent difficulties. One formidable problem is that of designing and building, at reasonable cost, a derrick structure capable of withstanding the winds of hurricane force that occasionally sweep across this region at certain seasons of the year. This article outlines the engineering details and calculations involved in the design of a derrick structure now in use. It is the first of its kind on the Gulf Coast for drilling in open water and presages a trend that will have an important bearing on the economical development of fields underlying open water.—*The Editor.*

BUILDING a derrick structure one mile out in the open waters of the Gulf of Mexico presents problems in design not encountered in land exploration. Occasional high winds of hurricane force and the severe wave action resulting therefrom are two prominent factors that govern the design. It is these factors with which we are chiefly concerned in this article, which sets forth some of the important engineering details and calculations employed in designing and building a derrick structure to withstand winds of high velocity and resist the forces of resulting wave action. The structure discussed is one of the first of its kind to be employed for drilling service in the open waters of the Gulf of Mexico. The well is strictly a wildcat, the drilling of which called for a depth of 10,000 ft. if necessary. It is a joint operation of the Superior Oil Company and the Pure Oil Company and is known as the Superior-Pure Oil Company Gulf of Mexico State No. 1 well.

Two major considerations in designing a structure of this kind are cost and stability. As the well was a wildcat, certain factors of permanency were sacrificed in favor of cost, but not at the expense of adequate stability under severe wave action and winds of high velocity. Different methods of construction were considered, such as: building an island of sheet steel piling; the use of caissons to drive batter piling and pouring concrete footing around the top of the piling on which steel columns extending out of the water would be set. A brief analysis of the various methods considered indicated that the conventional creosoted wood piling type of structure would be most economical and could be built with a high degree of stability and safety. A creosoted wood piling pier extending from land to the well was contemplated, but as the cost of such a pier would be about $20.00 per lineal ft. (total cost $110,000) it was not considered justified, particularly in view of the uncertainty of obtaining commercial production.

Original plans for the structure—as will be observed from the accompanying illustrations—assumed that a large modern steam drilling rig would be employed. Provision was made for five 125-hp. boilers of 350-lb. working pressure and two drawworks and engines. Later, when the structure was well along toward completion it was decided to use a large Diesel-electric rig for drilling. For this reason part of the piling structure was not capped, even though the piling was driven.

As the location of the well fell in an area under the jurisdiction of the United States War Department, all plans and specifications had to be filed

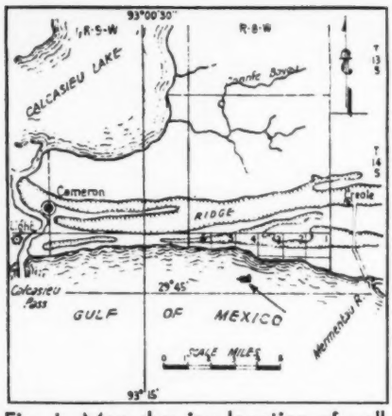


Fig. 1. Map showing location of well

with and meet the approval of the War Department Engineer at New Orleans.

The exact location of the well and the cross section of water soundings are shown on Figs. 1 and 2. It will be observed that water depth at MLT (mean low tide) is approximately 14 ft. and at high tide 16 feet. The well, 5300 ft. offshore, is approximately ten miles east of Cameron, Louisiana, and the mouth of the Calcasieu River, which is navigable.

CALCULATIONS FOR PILING STRUCTURE

The structure was designed for a wind velocity of 150 miles an hour. Approximately 300 piles were driven, as shown in Fig. 3. The calculations for the piling structure are given here in detail.

Unit	*Maximum Loading*	*No. Piles at 14 tons/pile*
Derrick	560,000 lb.	20
Rotary	300,000 lb.	18
Engine	40,000 lb.	12
Pipe Rack	350,000 lb.	20
Each 500-bbl. Tank	250,000 lb.	9
Boiler Platform	250,000 lb.	25
Mud House	100,000 lb.	6

Considering: Tendency of derrick to overturn:

Steel derrick 136 ft. high by 30-ft. base

Wind area on one side = 346.6 sq. ft.

Wind area on two sides = 693.2 sq. ft.

Center of wind gravity = 62 ft.

$P = .0024\ V^2$ where P = Pressure in lb./sq. ft. exposed area

Assume wind vel. of 150 miles/hr.

$P = .0024 \times 150^2$

$= .0024 \times 22{,}500$

$= 54$ lb./sq. ft.

¼ of 693.2 = 173.3 sq. ft. per leg or corner

173.3×54	= 9,350 lb.
$9{,}350 \times 62$	= 580,000 ft-lb.
580,000/30	= 19,300 lb.
Wt. of derrick	= 44,000 lb.
¼ of 44,000	= 11,000 lb.
and	
19,300 — 11,000	= 8,300 lb.

This force of 8300 lb. is that tending to overturn the derrick. Each corner will therefore have to be tied to piling in excess of 8300 lb. with strap iron.

In consideration of capping timbers other than derrick:

Assume No. 1 dense structural shortleaf yellow pine with shear value 150 lb. and bending stress of 1200.

As per Southern Yellow Pine Manual a span up to 11 ft. is permitted with an 8 by 12 timber in horizontal shear. Inasmuch as the maximum span being used is approximately 4 ft. the limitation of the timber is in horizontal shear and may be determined as follows:

$W = 4/3$ bds, or

$= 4/3\ 11.5 \times 7.5 \times 150$

$= 17{,}250$ lb.

Maximum load per span will be approximately 14,000 lb.

Considering the maximum condition being under the mud tanks where 18 4-ft. spans are required to carry 250,000-lb. static load, or 14,000 lb. per span, 8 by 12 timber is therefore more than adequate.

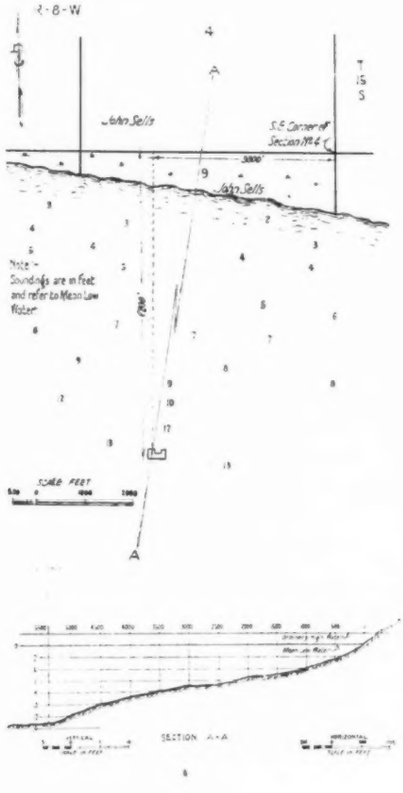
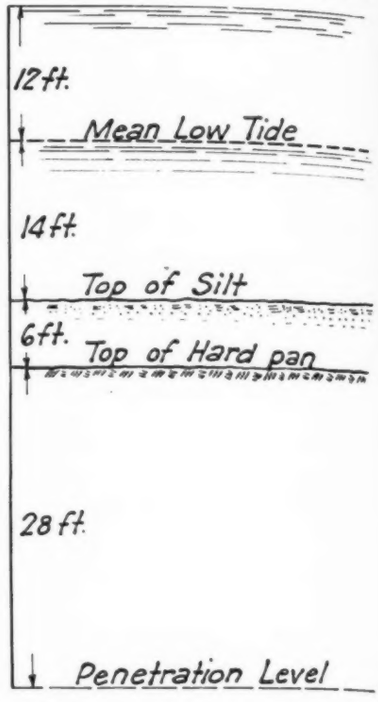


Fig. 2. Top: Plat showing soundings in feet at mean low water. Bottom: Cross section showing dip of floor offshore

Two core tests made to investigate the use of piling yielded the following information. These core tests proved



misleading inasmuch as it was necessary to scab each pile with four 6 by 8 timbers to get the bearing value on the piles.

Investigation of pile as a column:

Total unsupported length	= 32 ft.
Avg. dia.	= 11 in.
Avg. area	= 95 sq. in.
L/D unsupported	= 35

Considering simple column and long time loads, and an L/D of 35, then:

$$P/A = \frac{.274\ E}{(1/d)^2} \text{ or } \frac{.274 \times 1{,}600{,}000}{\left(\frac{384}{11}\right)^2}$$

$= 360$ lb./sq. in.

where:

P/A = max. load per unit cross-section area.

Then:

$360 \times 95 = 34{,}200$ lb.

Inasmuch as all piling will have bracing that would increase the above value materially there would be no question regarding the strength of the pile in this respect.

Investigation of specifications on the driving of the piles:

Using *Engineering News* formulae

$P = 2\ wh/s + 1$

Assuming 30,000 lb. as max. load to place on pile, then

$$15 = \frac{2 \times 1.5 \times 10}{s + 1} \text{ or}$$

$15\ s + 15 = 2 \times 1.5 \times 10$ or

$$S = \frac{2 \times 1.5 \times 10 - 15}{15} = \frac{15}{15}$$

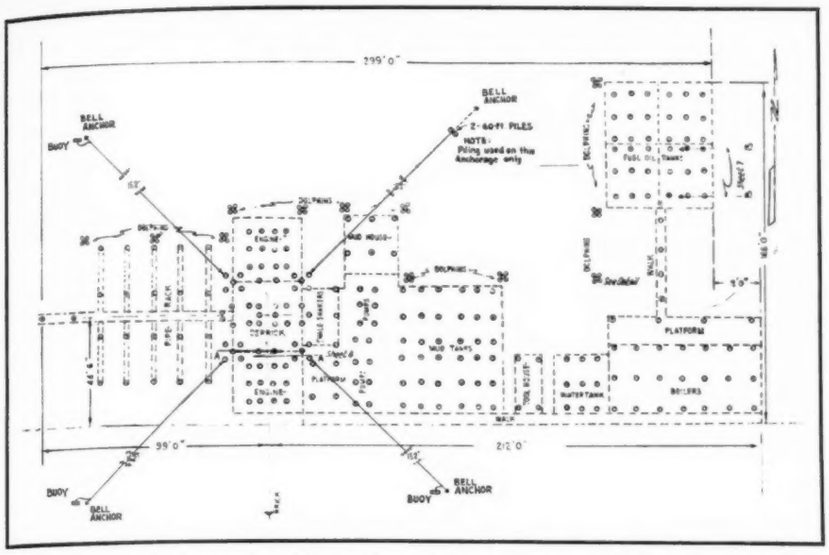


Fig. 3. Plan of piling and guy wire anchors

= 1 in. penetration on last blows of hammer where

P = load in tons
W = wt. of hammer in tons
h = height of fall of hammer in ft.
s = penetration on last blow.

An important consideration in design was that of guying the derrick to withstand a 150-mile-per-hr. wind. The location and magnitude of forces necessary to keep the derrick in equilibrium were calculated, and it was determined that anchoring facilities provided at each corner should be sufficient to overcome a total force of 28,680 lb. per corner (see calculations of guy wire stresses). This was based on a force of 8300 lb. tending to overturn derrick.

A piling cluster was first considered in which the guy wires would be fastened at a point above the water, but this was impractical. Calculations indicated that a cluster of 64 piles for one corner would be required. After considering various methods of anchoring, it was decided to apply bell anchors as shown on Fig. 4. This method of anchoring lends itself to economical application and also provides a positive means of anchoring.

ANALYSES OF DERRICK AND GUY WIRE STRESSES

Wind press. = $.0024 \times V^2$
For 150-mile wind
$P = .0024 \times 22{,}500$
$= 54$ lb./sq. in.

Wind load at any panel point = (½ projected area of panel above) + (½ projected area of panel below) × 54 lb./sq. in. × 2 for area of two opposite sides of derrick divided by 2 for arriving at one plane of derrick.

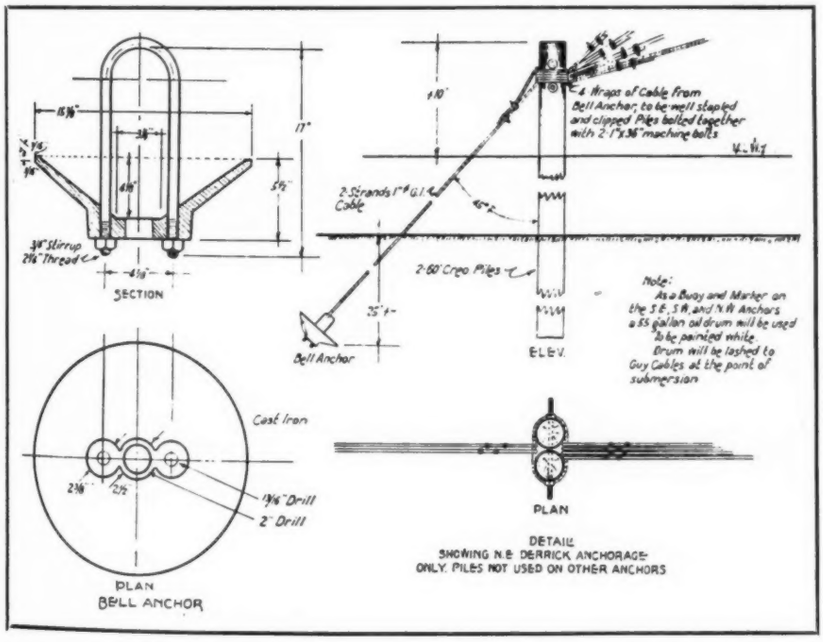
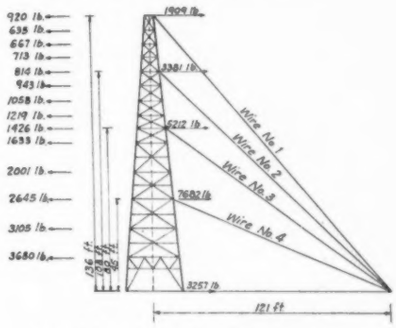

SECTION
4 Wraps of Cable from Bell Anchor, to be well stapled and clipped Piles bolted together with 2-1"x36" machine bolts
2-Strands 1" G.I. Cable
2-60' Creo Piles
Bell Anchor
ELEV.
Note: As a Buoy and Marker on the S.E., S.W. and N.W. Anchors a 55 gallon oil drum will be used to be painted white. Drum will be lashed to Guy Cables at the point of submersion
Cast Iron
1 1/16" Drill
2" Drill
PLAN
BELL ANCHOR
PLAN
DETAIL
SHOWING N.E. DERRICK ANCHORAGE
ONLY. PILES NOT USED ON OTHER ANCHORS

Fig. 4. Detail of bell anchors for guy wires

Proposition: To guy a derrick properly under following conditions:



(1) To relieve derrick members of max. amt. of stress.

(2) To arrive at the amount of stress imposed upon each wire to keep the derrick in equilibrium and proportion size of wires accordingly.

Obviously condition (1) can be satisfied fully by attaching a guy wire to each panel point. But as the guy line would in each case be reacting immediately at the point of application of load without the load having to pass through other members to get to the reaction, this would be impractical because of the cost. The most rational basis would be to divide the derrick into four sections, allowing the stresses to accumulate between the points of application.

Assuming that the wind load has been computed for application at each panel point, condition (2) can be satisfied by considering the derrick as a continuous truss over five supports. Make the reaction at each support proportional to the loads and the spacing between their reactions. As a check, the moments of these reactions about the base of the derrick should equal the moments of the wind loads about the base (showing the derrick is in equilibrium).

For reactions Guy No. 1:

$$\frac{(713 \times 7) + (667 \times 14) + (635 \times 21)}{28} + 920 = 1909 \text{ lb.}$$

For reactions Guy No. 2:

$$\frac{(635 \times 7) + (667 \times 14) + (713 \times 21)}{28} + \frac{(1219 \times 7) + (1058 \times 14) + (934 \times 21)}{28} + 814 = 3381 \text{ lb.}$$

For reactions Guy No. 3:

$$\frac{(943 \times 7) + (1058 \times 14) + (1219 \times 21)}{28} + \frac{(2001 \times 14) + (1633 \times 28)}{35} + 1426 = 5212 \text{ lb.}$$

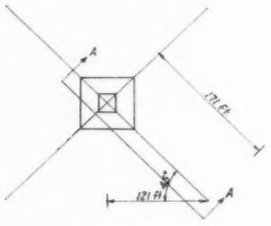
For reactions Guy No. 4:

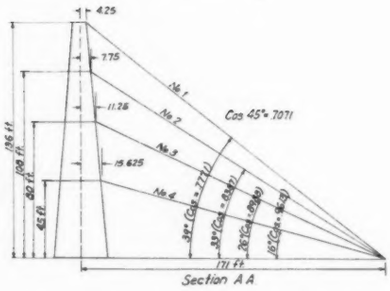
$$\frac{(1633 \times 7) + (2001 \times 21)}{35} + \frac{(3680 \times 17) + (3105 \times 31)}{45} + 2643 = 7682 \text{ lb.}$$

As a check—

Moments about base for wind loads =
(920 × 136) + (635 × 129)
+ (667 × 122) + (713 × 115)
+ (814 × 108) + (943 × 101)
+ (1058 × 94) + (1219 × 87)
+ (1426 × 80) + (1633 × 73)
+ (2001 × 59) + (2645 × 45)
+ (3105 × 31) + (3680 × 17)
= 1,388,252 ft-lb.

Moments about base for reactions =
(1909 × 136) + (3381 × 108)
+ (5212 × 80) + (7682 × 45)
= 1,387,422 ft-lb.





Converting reaction into horizontal plane of guy wire and then into the vertical plane of guy wire to obtain actual stress in wire.

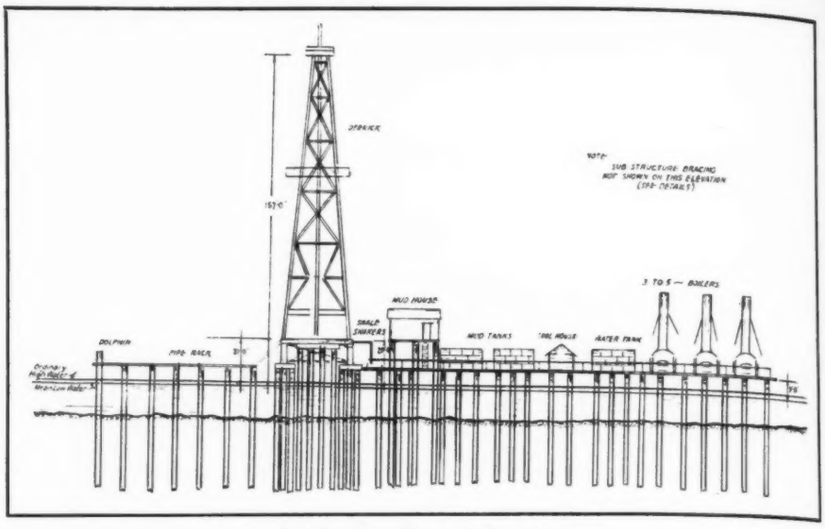
Guy No. 1 = $\frac{1909}{.7071 \times .7771}$ = 3,470 lb. actual stress in guy wire.

Guy No. 2 = $\frac{3381}{.7071 \times .8387}$ = 5,700 lb. actual stress in guy wire.

Guy No. 3 = $\frac{5212}{.7071 \times .8988}$ = 8,220 lb. actual stress in guy wire.

Guy No. 4 = $\frac{7682}{.7071 \times .9613}$ = 11,290 lb. actual stress in guy wire.

This is a total stress of 28,680 lb. in the four guy wires.

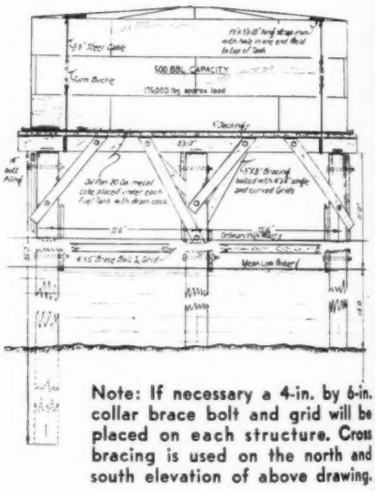


South elevation of structure

For guy wire No. 1 use ⅜-in. Grade J (6 x 19 strand) breaking strength 11,000 lb.
For guy wire No. 2 use 7/16-in. Grade J (6 x 19 strand) breaking strength 14,600 lb.
For guy wire No. 3 use ½-in. Grade J (6 x 19 strand) breaking strength 18,800 lb.
For guy wire No. 4 use 9/16-in. Grade J (6 x 19 strand) breaking strength 23,400 lb.

In order to make the structure as rigid as possible and obtain the maximum value of the timber bracing, use was made of connector steel grids bolted throughout.

In designing this drilling structure the magnitude of wave forces was kept in mind. It is important to note that a 150-mile-per-hr. wind will exert a force of 54 lb. per sq. ft., whereas the force exerted by wave action at this wind velocity may be as great as 3000 lb. per sq. foot. It is desirable to keep the floor of the structure sufficiently high to eliminate or minimize the upward thrust of waves, or to prevent waves breaking on the flooring. Practically all cross-bracing was run in a north-south direction in order that the surface exposed to wave action would be the least. Collar bracing was used in cases of direct exposure to wave action. Connector steel grids were also used at all bracing points. The major items such as tanks, derrick, and boilers, were all designed with anchoring devices to prevent their being swept off. A round pile represents an ideal surface for minimizing force of wave action. The resistance of a flat surface having a width equal to that of the diameter of the pile, is probably five times as great as that of a round surface.



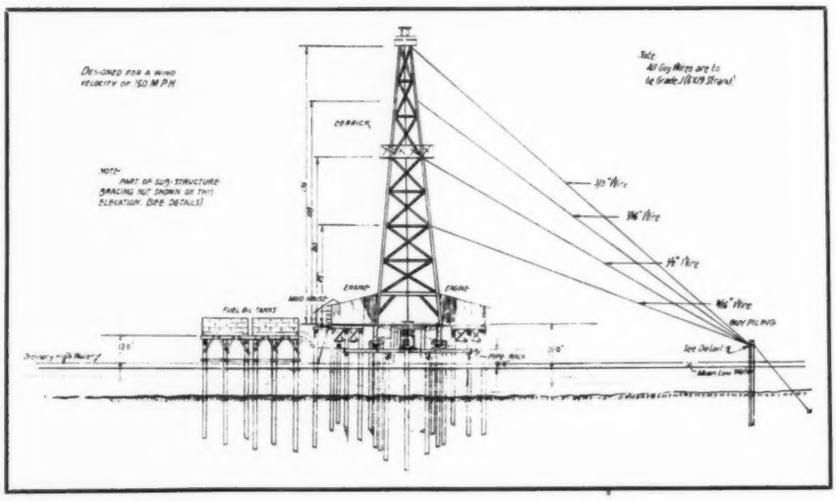
Note: If necessary a 4-in. by 6-in. collar brace bolt and grid will be placed on each structure. Cross bracing is used on the north and south elevation of above drawing.

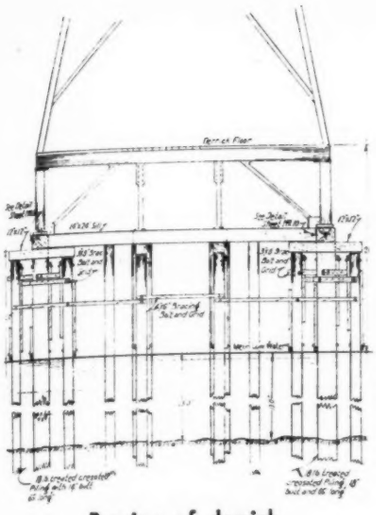
Fuel tank foundation

There is a valuable facility in the vicinity in the form of a jetty, which extends from shore one mile out into the Gulf on the east side of the river mouth.

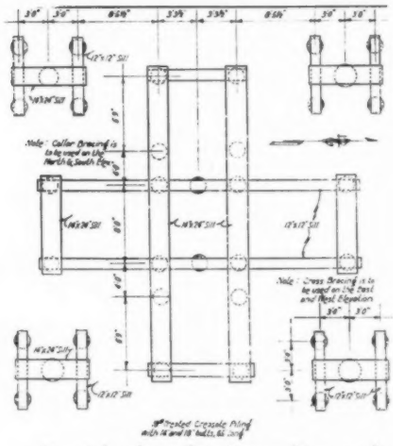
During drilling, coast-wise tugs and barges are necessary for transportation

West elevation of piling structure. Guy wire anchor shown was used on northeast corner only

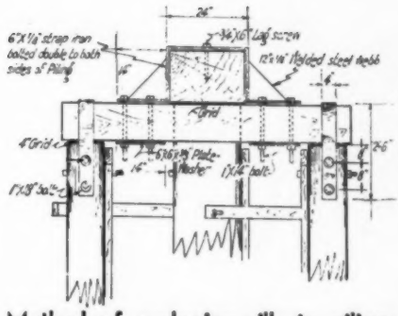




Bracing of derrick



Derrick plan showing piling and capping only

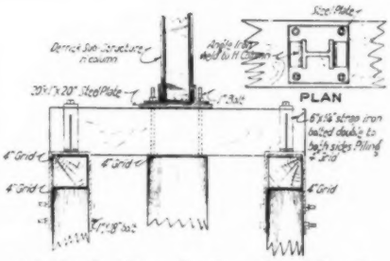


Method of anchoring sills to piling, derrick foundation

of men and supplies. These vessels must meet certain coast-wise Marine requirements that are more rigid than those of inland-water operations.

Some four months were required for construction. There were many days when the construction crews would make the 10-mile boat trip from Cameron to location only to find the water so rough that the men could not be transferred from tug to structure. Even on comparatively still days the water would be fairly rough due to continuous swells.

Drilling began October 6, 1937, and good progress was made to a depth of 9313 ft., reached on January 26, 1938. On March 10 the depth was 9394 feet. The 7-in. casing was set at 7000 ft. and after plugging back was perforated between 5110 and 5130 ft. in a producing sand logged at 5110 to 5180 feet. Production tests March 12 gave 25 bbl. of 33.8-deg. oil per hour through ¼-in. choke, accompanied by an undetermined volume of gas. The pressure was 850 pounds.



Method of anchoring derrick substructure to sills

Should this well prove commercially productive an interesting problem in development is in prospect. In fact, the problem is now under consideration on the chance that the well may be productive. One program of development contemplated would consist of developing the field by locating central drilling points, from each of which would be drilled nine wells, eight of which would be slant-drilled by using directional surveys. All central points would be interconnected by piers, from which all drilling and producing operations would be conducted.

The writer wishes to acknowledge the assistance of J. E. Wilkerson of Nowery J. Smith, Houston, who made the analyses of derrick and guy wire stresses, and of D. L. Alexander of the Connector Construction Company, Houston, who was of valuable assistance in the design of the timber.

Final Report on Explosion in New London, Texas, School Building Made by Bureau of Mines

THE immediate cause of the disastrous explosion in the school building at New London, Texas, which occurred on March 18, 1937, was the ignition of a large volume of natural gas-air mixture that had accumulated in an inadequately ventilated space under the building because of leakage from the gas line, states the Bureau of Mines in its final report on the explosion. This leakage may have been from a broken service connection in the north portion of the space. The dangerous gas accumulation was not caused by seepage from the ground or from nearby wells or lines, the report further states. The ignition was caused by an arc or spark from an electric switch, and the heating units did not contribute to the ignition. The source of gas supply is irrelevant.

Investigators of the Bureau of Mines, equipped by long experience in the technologic aspects of the safety, explosive, and natural gas work of the Bureau, were called at once to the scene of the accident and made a thorough examination of the situation and circumstances of the tragic occurrence. Their findings are now made available through a 29-page paper, Report of Investigations 3365, "Explosion in School Building at New London, Texas, March 18, 1937," by D. J. Parker, G. W. Jones, H. B. Hill, and Gustav Wade.

The report points out that suitable warning agents introduced into fuel gases that have little or no odor of their own have been useful in detecting leaks, and that alarm systems for detecting leaks have value but do not really solve the problem. It recommends that gas and electrical equipment be installed in accordance with the requirements or recommendations of national associations or in accordance with codes that have established standards of safety, such as the recommendations of the American Gas Association and the National Electrical Code. Installations should be made only by responsible and experienced personnel, and all gas lines should be installed only in well ventilated places in such a manner as to be free from unusual strain. Buildings should be sealed against ground seepage; public buildings should be subject to inspection by a competent state supervisory body, and the coöperation of gas companies and their experienced personnel should be enlisted to aid in minimizing hazards.

A Theory of the Corrosion-Time Relationship for Underground Pipes*

By

NORMAN L. HOFF, Engineer, Southern California Gas Company

THE true nature of the corrosion-time relationship governing the behavior of ferrous metals is, without doubt, very complex and possibly may never be precisely defined. Notwithstanding its complexity, numerous investigators have speculated on the nature of this relationship, and have proposed various theories in attempting to explain it. Thus far, no theory seems to have been advanced that is entirely adequate to explain all the varied behaviorism. In presenting a further theory to those already to be found in the literature, the author appreciates that the obscurity has been lessened but little; however, the challenge inherently embodied in any theory is often a valuable stimulus to further research, and on this premise it is ventured to present the following discussion.

Perhaps the best known theories of the corrosion-time relationship have been advanced by Pilling and Bedworth[1] and Evans[2]. The former were primarily interested in high temperature oxidation, and the latter was investigating the growth of films and atmospheric tarnishing. Notwithstanding the wide difference in nature of these phenomena, the investigators placed credence in the theory that the corrosion-time relationship was parabolic in nature. In substance, they have asserted that the rate of corrosion is inversely proportional to the thickness of the layer of corrosion products. Thus, if (y) is the thickness of the oxide layer and (x) is the time:

$$\frac{dy}{dx} = \frac{K}{y}$$

whence,

$$\int y\,dy = K\int dx$$

and,

$$y^2 = 2Kx + C \quad - - - - - \quad (1)$$

Although an equation of this type may provide a reasonable explanation of some types of corrosion, it is doubtful if it adequately explains the corrosion suffered by ferrous metals buried in the soil. Also, it will be observed that when Time is zero, and consequently pitting is also zero, the rate of corrosion becomes infinite, indicating that equation (1) is not valid at the lower limit.

Brennan[3], who was aware of this difficulty, enounced a substitute based on the hypothesis that the rate of corrosion is inversely proportional to the time. Thus he wrote:

$$\frac{\delta y}{\delta x} = Z\left(\frac{K}{x}\right)$$

where (Z) is a function of the corrosivity of the soil. In order to escape an infinite corrosion rate at zero time, he introduced an arbitrary constant (h). Thus,

$$\frac{\delta y}{\delta x} = Z\left(\frac{K}{x+h}\right)$$

and,

$$\int \delta y = ZK\int \delta x\,\left(x+h\right)^{-1}$$

whence, he finally obtained for soils of the same corrosiveness,

$$y = K\log\left(\frac{x}{h}+1\right) \quad - - \quad (2)$$

The reasoning upon which Brennan's equation is based is sound, the mathematics is flawless, and application to experimental data covering the initial stages of soil corrosion demonstrates a satisfactory fit. However, practical experience would tend to show that small pipes buried in the earth do not last in excess of 10,000 years, even under the mildest of conditions, a conclusion that Brennan's equation would seem to indicate.

Passano[4], finding it difficult to reconcile a parabolic theory with his observations, surmised that the initial stages of corrosion were linear in character, and after a certain period the relation then became parabolic. In other words, he imagined corrosion as proceeding in two distinctly different stages.

A study of almost 4000 pit depth measurements on bare steel and wrought iron pipes of various ages in Southern California soils has disclosed the inadequacy of all the foregoing theories in explaining the characteristics exhibited therein. In seeking to explain the inconsistencies, the writer emerged from the study with the fairly strong conviction that the corrosion-time relationship in this particular instance is logarithmic in nature. Examination of similar data from other sources further strengthened this conviction.

Such an idea is not unreasonable, for it is possible to develop rationally this very relation from reliably reported experimental observations. For example, let it be assumed, without justification for the moment, that the rate of corrosion is directly proportional to the depth of the pit and inversely proportional to the time. Then we may write:

$$\frac{dy}{dx} = K\left(\frac{y}{x}\right)$$

Then, separating variables and integrating:

$$\int y^{-1}\,dy = K\int x^{-1}\,dx$$

whence,

$$\log_e y = K\log_e x + C$$

or,

$$\log_e y = K\log_e x + \log_e C$$

from which,

$$y = C\,x^k \quad - - - - - - \quad (3)$$

The primary justification for a development such as this is on strictly empirical grounds; an equation similar to (3) being, usually, superior to other types in the fitting of pit depth-time measurements on buried pipes. It has independently been shown by Ewing[5] that this type of expression is a satisfactory fit for the Bureau of Standards pitting data on some 5500 specimens, exposed to the soil from two to twelve years, in 47 test sites distributed throughout the country. In general, evidence of an empirical nature is strongly in favor of the log-log or power type equation.

Aside from empirical considerations, there is considerable evidence that would appear to support the fundamental relationship from which the log-log expression was derived. In order to demonstrate this, it is necessary to show that there are two forces at work in the corrosion process: (1) a force or forces tending to accelerate corrosion and, (2) a force or forces that tend to decelerate corrosion.

*Paper presented at National Bureau of Standards' Fourth Underground Corrosion Conference, Washington, D. C., November, 1937.

The stimulating influences are none too well defined, and of such little importance in the broad and practical aspect of the corrosion problem that they have largely been overlooked or forgotten. That there was such an accelerating effect in corrosion was appreciated as long ago as 1849, when Mallet[6] observed, "As every metal is electro-positive to its own oxides, the adherent coat of rust upon the iron, while it remains, powerfully promotes the corrosion of the metal beneath." At a later date Lewes[7] and Schleicher and Shultz[8] expressed a similar opinion. As a result of extensive experiments in 1912, Aston and Burgess[9] declared, "The accelerating influence of an initial rust formation upon subsequent rusting is demonstrated. The accelerating action is probably greater when there is only a small amount of rust on the surface than when the rust increases in thickness." A few years later Aston[10] remarked further, "Rust is an accelerator of further rusting. Since rust promotes electrolytic effects . . . its influence in accelerating further rusting must be conceded." In reporting experiments of the Bureau of Standards, McCollum and Logan[11] wrote, ". . . the formation of iron oxide which results from the initial stages of corrosion may set up galvanic couples which did not before exist and thus greatly increase the self-corrosion on the specimen." That Speller[12] concurs in this opinion is apparent from his statement, "If the rust coating is loose and non-adherent, under ordinary conditions the rate of corrosion may be accelerated locally . . ." Similar statements may also be attributed to Friend[13], Pollitt[14], and Vernon[15].

Discussing this action from a slightly different viewpoint, Ewing[16] explains, "If there is an abundance of oxygen in the soil, the ferrous salts and hydroxide do not move very far before they are precipitated by the oxygen, forming less soluble ferric hydroxide and releasing the negative ions. The negative ions then migrate back toward the bottom of the pit to combine with more Fe ions. Hence, every anodic area or pit is a trap for the negative ions. They are driven toward it by the galvanic current; there are few positive ions with which to combine except iron. . . ."

Although generally less important in soil corrosion, we may list additional stimulators as follows: injuries to the pipe such as dents and scratches, mill scale, mechanical and residual welding stresses, stray current electrolysis, and dissimilar metals.

From these citations it would appear justifiable to assume that in the very early stages of corrosion, the corrosion rate is directly proportional to the amount of oxides present, or if the amount of oxides be (R):

$$\frac{dy}{dx} = K R \quad - - - - - - \quad (4)$$

But as the oxides must be created by the corroding away of the pipe's surface, or perhaps by the formation of pits, we may say that (R) is proportional to (y), the depth of the pit. Therefore:

$$y = K R \quad - - - - - - \quad (5)$$

The inhibitive factors in the corrosion process have been studied much more intensively, and it is now almost universally accepted that the corrosion rate diminishes with time. The factors contributing to the slowing down of corrosion have been ably summarized by Brennan[3], as follows: ". . . formation of inhibitive scales of soil or corrosion products or both; polarization by hydrogen film; decrease in the supply of oxygen, thus retarding de-polarization of the element; depletion of the reactants; leaching out of soluble salts; and the change of soluble salts to insoluble secondary compounds." As all these factors are in some manner related to time, and there is good reason to believe that this relation is reciprocal, we may write:

$$\frac{dy}{dx} = K \left(\frac{1}{x}\right) - - - - - \quad (6)$$

In order to evaluate the net influence of both the accelerating and decelerating factors, we combine (4), (5), and (6) as follows:

$$\frac{dy}{dx} = K \left(\frac{y}{x}\right) - - - - - \quad (7)$$

which, it will be seen, produces the fundamental relation from which (3) was derived. It may be imagined, therefore, that the corrosion initially propagates in somewhat the same manner as micro-organisms multiply in a suitable culture medium, or more commonly, in accordance with the "compound interest law." It is fortunate, however, that the decelerating factors associated with time are more powerful than the accelerating factors associated with pit depth.

We may dismiss the equations of Pilling and Bedworth, Evans, and Passano as not being generally applicable to soil corrosion by inspecting the results of the Bureau of Standards burial tests, and by comparing with other field data. On the other hand, it is not so easy to dismiss the semi-logarithmic relation of Brennan. As a matter of fact, for the initial stages of corrosion, it can be demonstrated that the semi-logarithmic equation is almost as reliable, statistically, as the log-log expression. This is especially true in the case of the 4000-odd pit depth measurements in Southern California soils, to which reference has already been made. Fitting curves of the two types by method of least squares, we obtain the following criteria of their appropriateness:

	Semi-Log	*Log-Log*
Index of Determination	0.697	0.702
Index of Correlation	0.835	0.838
Probable Error	7.24 Mils	7.18 Mils
Standard Error of Estimate	12.7 Mils	12.6 Mils

By comparing the indexes of determination, we see that the log-log type of equation accounted for only one-half percent more of the total variation in pit depth, by attributing such variation to time, than did the semi-log. In view of the fact that the original pit depth measurements probably did not have an average precision greater than five to ten mils, we may

CONTINENTAL'S WELL NOW 2 2/3 MILES DEEP

Continental Oil Company's well No. A-2 K. C.L. was still drilling at a depth of 14,121 ft. on March 11th. The top of a sandy zone entered at 13,125 ft. is thought to be the top of the Rio Bravo. A showing of oil was observed at 13,130 ft., and another indication at 13,827 feet. Present plans are to drill at least 100 ft. deeper, after which, if there are no further signs of commercial production, the open hole will be electrically logged its entire depth, a temperature survey made, and other information of value procured to supplement the drilling and coring logs.

justifiably assume that either type of equation is a good fit.

It is apparent, therefore, that on a statistical basis alone there is little choice between the two types of formulae. However, if we attempt to explore the region far beyond the first ten to fifteen years of corrosion by using the derived equations for extrapolation, we at once are beset with difficulties. The well-known characteristic of the semi-logarithmic curve to become very flat with high values of the independent variable, produces ages necessary for pit depths to equal standard pipe wall thicknesses far beyond any reasonable bounds. On the other hand, the log-log or power type of equation, because it flattens much less rapidly, produces ages that are more within reason.

Although it would be much more satisfactory to discard the semi-logarithmic relation because of failure to fit actual observations, yet for the present it appears we must be content with the analysis based upon the characteristics exhibited by extrapolation. This will be true until someone produces some reliable measurements of pit depths on pipes older than 15 to 20 years. Such measurements, in this range and beyond, as have come to the writer's attention all display the same type of unreliability. That is, these measurements not only show that corrosion no longer progresses, but the pits actually become less deep with time. We may speculate as to the cause of this, and it does seem reasonable that part of this behavior can be accounted for by the following reasons: (1) general corrosion may have removed the original surface of the pipe so that pit depth measurements are taken from the wrong datum and, (2) some, or many, pit depths may have become perforations so that there is no way of measuring how deep the pit would have been had there been additional metal to penetrate. Then, too, the World War period falling about this time may have restricted the universe from which measurements are taken corresponding to some of these ages.

Based on the meager evidence at hand, it is too much to say that an equation similar to (3) adequately expresses the corrosion-time relationship for underground pipes, but it appears justifiable to attribute to it superior qualifications over the other relations considered.

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Foreign Crude Oils Analyzed by Bureau of Mines

ANALYSES of more than 140 samples of crude petroleum from oil fields of Europe and the Eastern Hemisphere are reported in a bulletin of the Bureau of Mines, just issued.

On the whole, the yield of gasoline compares favorably in quantity and quality with that from crude oils of the Western Hemisphere, the report points out. An outstanding characteristic of the Eastern Hemisphere crude oils is indicated by their sulphur content and carbon residue of the residuum. These two figures indicate that most of the crude oils would be excellent for manufacture of motor fuel by cracking.

There has been a dearth of information readily available in English on the characteristics of oils produced in these fields. Accordingly the Bureau of Mines undertook the collection, analysis, and study of these oils. This work was prompted by two main reasons: foreign fields are potential sources of supply for the United States (in fact, considerable quantities of some foreign oils already have been imported), and oils from many foreign fields are similar in physical and chemical properties to oils in the United States, and a study of these resemblances has scientific and commercial value. The analyses in this bulletin offer a means for judging the relative values of the foreign crude oils compared with familiar crude oils of the United States that have been analyzed by the Bureau of Mines method.

The Bureau's analyses indicate that the gasoline content of these crude oils varies widely; some samples contain no gasoline distillate although others contain more than 80 percent distilling at a temperature less than 392 deg. fahrenheit. (200 deg. centigrade).

The gravities of the samples also vary widely, although most of them are heavy. Only 48 of the 142 samples (33.8 percent) are lighter than 35.0 deg. A.P.I. (specific gravity 0.850). The sulphur contents vary widely. Samples from Albania and Greece and two samples from the Ural Province of Russia contain the most sulphur. These samples average 4.9 percent sulphur, in contrast to 37 samples (26.1 percent) that contain less than 0.1 percent sulphur. The crude oils as a whole have low viscosities. Although many of the oils have relatively high pour points, the high-pour-point oils have low viscosities at 100 deg. fahr. or below, indicating that the oils can be transported readily by pipe line.

The bulletin includes comments, tabulated data, and individual analyses of 142 samples of crude petroleum obtained from Albania, Czechoslovakia, France, Germany, Great Britain, Italy, Poland, Rumania, Yugoslavia, Greece, Union of Soviet Socialist Republics (Russia), Iran (Persia), Iraq, India, Japan, East Indies, New Zealand, Algeria, Egypt, and Angola (Portuguese West Africa). Most of the samples were taken directly from wells or from field storage tanks, and in the main represent oils from Tertiary formations less than 3000 ft. below the surface; many at depths less than 1500 feet.

In addition to the individual analyses, the bulletin contains tabulations of the analyses, maps of oil fields and pipe lines of some countries, and references to articles giving additional information on the characteristics of the crude oil, the geology, or other pertinent information on the petroleum industry of each of the countries. Data on production of petroleum have been quoted from Government statistics of countries for which official statistics are available; in the absence of official figures semiofficial or commercial statistics have been used.

The bulletin also has a tabulated summary of analyses made by the Bureau of Mines of 315 samples of crude petroleum from fields throughout the world, including the 140 samples from the Eastern Hemisphere, classified according to "base" by the Bureau's method.

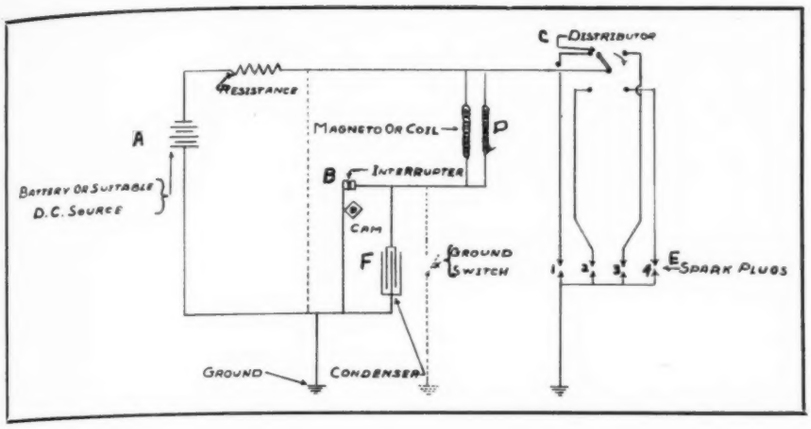


Fig. 1. The battery and resistance are eliminated when using a magneto and the circuit is as indicated by the broken lines

By
C. C. KEANE

Ignition Systems for Internal Combustion Engines

Rapid development in engine design has been accompanied by marked improvement in the design of electric ignition apparatus

THE rapid development of the gas and gasoline engine in single- and multi-cylinder designs in the past decade, under economic stimulus, has been accompanied by marked improvement in the design of electric ignition apparatus.

Probably no other factor has contributed so greatly to the degree of perfection attained by modern Otto-cycle internal combustion engines as have the refinements in the electric ignition system. The fundamentals as originally devised remain unchanged but even these are incomprehensible to the majority of users of this type of engine.

The purpose of an ignition system is to start the combustion of the atomized liquid or gaseous fuel charge at the correct cyclic instant; this should occur when the charge attains the point of maximum compression.

A schematic arrangement of the ignition circuit is illustrated in the accompanying diagram, Fig. 1. It consists of (A) an electric power generating unit, battery, magneto, or appropriate d-c. supply, (B) an interrupter timed to synchronize its breaking action with that of the cylinder in which the explosive mixture is to be ignited, (C) a distributor also properly timed to conduct the high potential energy to the respective cylinder plugs in proper firing order, (D) a high-tension coil, which in some types of magnetos is an integral component, for transforming the primary low-voltage current to secondary high-potential current, (E) a spark plug, which in modern designs may be defined as a fixed gap one side of which is insulated and across which the high-potential spark is emitted, and (F) a condenser connected to the interrupter contact points to absorb the current that otherwise would be carried across those points at the instant of interruption, and cause fusing and disintegration of the contact point metal.

A hydraulic analogy of the function of a condenser is depicted in Fig. 2,

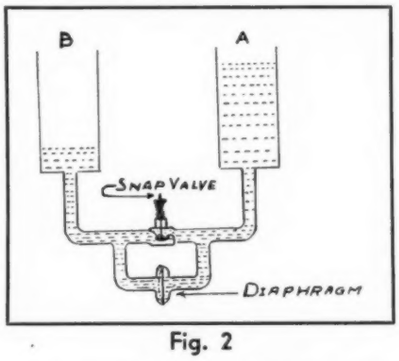


Fig. 2

an explanation of which follows: Instantaneous closing of the snap valve interrupts the flow of liquid from a point of high potential (A) to a point of low potential (B), simultaneously suppressing its kinetic inertia. This action causes the diaphragm to depress until a momentary balance is attained, when it immediately rebounds causing a surge of liquid back to tank (A). The cycle repeats itself several times until loss of energy eventually attenuates it. The oscillating surge is analogous to the successive discharges of a condenser.

Combustible mixtures consisting of air and any commercial hydrocarbon in the correct ratio are readily ignited by means of a spark plug. An electric spark passing between the plug points, as shown in Fig. 3, ignites

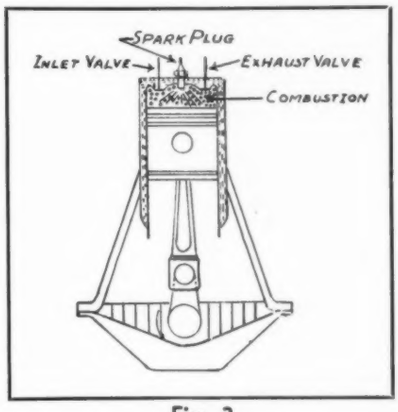


Fig. 3

the adjacent layer of combustible mixture in intimate contact with the electrodes. Firing of this mixture is not instantaneous, the rate of flame propagation being relatively slow unless the physical and chemical characteristics of the fuel are such that combustion proceeds at a rate sufficient to cause detonations; if the fuel is suitable, combustion proceeds at a constantly accelerated rate, accompanied by temperature and consequent pressure increases until the charge is com-

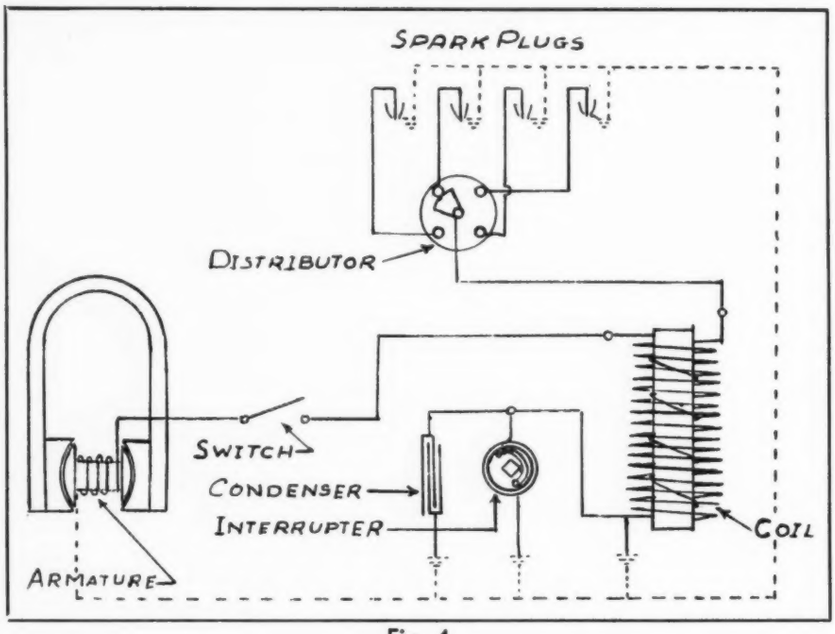


Fig. 4

pletely ignited. The rate of flame propagation is defined as the time required for a charge to become completely consumed after igniton.

The magneto fundamentally is an electric generator operating on the magnetic induction principle, its magnetic field originating in the permanent magnets. It is divided into two general classifications, low-tension and high-tension, from which come the sundry ramifications that include two-spark magnetos, shuttle type, inductor type, and oscillators. The low-tension magneto, schematically illustrated in Fig. 4, generates a current of low voltage. It has only a primary winding, so an external high-tension coil is required to effect the necessary voltage increase that incites the spark to jump the gap. Low-tension magnetos of the oscillating type are sometimes operated in conjunction with a make-and-break type igniter similar to that depicted in Fig. 5. This type of system and igniter are preferred by some engine manufacturers for use on engines in which compressions exceed 150 lb. per sq. in., because for such use it is claimed that conventional spark plugs are unreliable due to the increased resistance of the spark gap to the passage of high-voltage current; however, intensive research by numerous analysts has tended to discredit this contention.

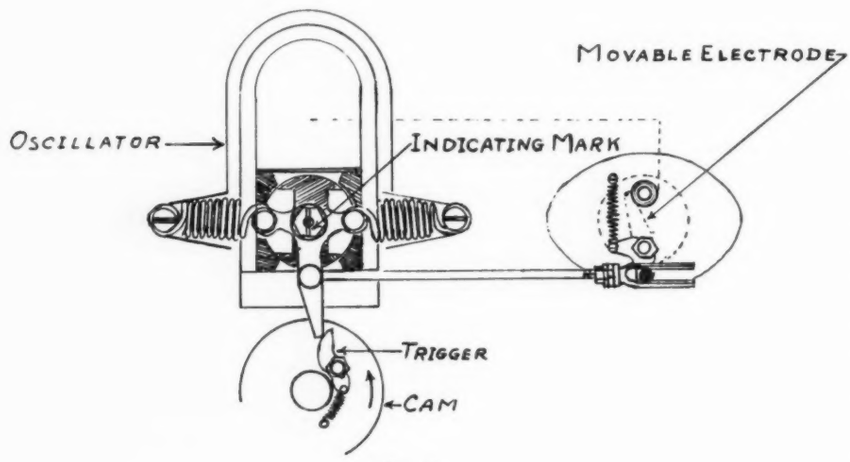


Fig. 5

Magnetos that generate current of sufficiently high voltage to operate jump spark ignition plugs without the addition of detached or built-in high-tension coils are classified as high-tension magnetos. Confusion is sometimes caused by identifying as high-tension types those magnetos to which the induction coil is attached for conservation of space or for convenience. This is not technically correct and magnetos incorporating this arrangement actually belong in the low-tension classification. In the strictly high-tension magneto the armature or coil of the armature and inductor-type magnetos, respectively, incorporate a secondary and primary winding.

Accessories included in the high-tension magneto are the condenser, interrupter, distributor, and impulse starter, if used, and, generally speaking, all the essentials necessary for the production of spark plug current. A circuit diagram of a typical high-tension magneto is given in Fig. 6; however, space is not available for a complete discussion of the numerous types, ramifications, and peculiarities of high-tension magnetos.

The cycle involved in relationship to the spark production by high-tension shuttle-type magnetos is described as follows: The primary and secondary windings rotate with the armature between the pole pieces of the permanent magnets, and current flows around the armature core through both windings. At the instant when the generated voltage is greatest, the interrupter breaks the primary circuit, causing a demagnetization of the armature laminations. The high voltage induced in the secondary winding is a resultant of the interrupter action and it produces a spark of very short duration, designated as a pilot or conductor spark. The current generated in the primary winding, which is of lower

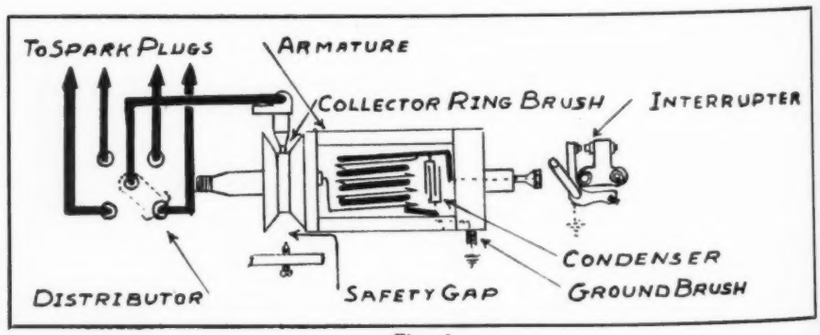


Fig. 6

voltage and is independent of the induced voltage but is not of high enough potential to jump the spark gap preceding the induced voltage, follows the conductor spark to ground, thus producing a hot arc of longer duration than the incipient high inductive spark. Circuit for the current is provided through the collector ring, distributor, spark plug wiring, and plug gap to ground, ignition occurring as the current traverses the spark plug gap. The spark plug gap becomes a conductor while the spark is taking place, thus permitting discharge of the condenser. The actual time of spark duration approximates $1 \times 10^{-4} = .0001$ seconds.

The exceedingly high voltage induced in the secondary winding, upon interruption of the primary circuit, would subject the insulation of this circuit to potentials that might damage it in the event of disconnection of the lead wire utilized as a conductor to the spark plug. Consequently, a safety gap is provided, one side of which is part of the secondary winding, the other side being grounded. This is analogous to a safety valve in hydraulic circuits and provides an emergency discharge for high potential current that might be prevented from following its normal course.

Magnetos, like all other electromechanical devices, are subject to failure; the frequency of failures can be reduced by careful scrutiny of the various electrical and mechanical structures at regular intervals. Development of magneto irregularities adversely effects engine performance. Factors causing the more common magneto failures and the procedure recommended for remedying them are enumerated as follows:

(1) Reversed magnet polarity will divert the magnetic flux from its proper course, causing disruption of the field through which the armature rotates or oscillates, consequently no electric energy will be generated. Magnet assemblies should be fabricated with similar poles adjacent to each other.

(2) Magnets of low field intensity cause weak ignition at decreased speeds and make starting difficult. The difficulty may be overcome by remagnetizing the magnets to the saturation point, and maintaining approximate equality in magnetic pull.

(3) Excessive interrupter gap causes point chattering and misfiring at high speed and early ignition at low speed. Inversely, contacts adjusted too closely will not positively interrupt the flow of current in the primary circuit, and as a result the high inductive effort necessary to spark production will be absent. Misfiring will result and will be particularly noticeable at high speeds. The interrupter points should be kept clean, and in contact with each other across the face surfaces, and should be adjusted to the gap opening recommended by the manufacturer, usually between .015 in. and .020 inch. Sandpaper or glasspaper is recommended for required cleaning of points. Interrupter points on high-tension magnetos commonly are made of platinum, so should not be filed for contact fitting except under unusual circumstances. Wear of the interrupter lever bushing and pivot pin or weakening of the lever spring are all contributary factors to erratic magneto performance and the remedies are evident.

A defective condenser readily identifies itself by excessive interrupter point arcing. A schematic wiring diagram showing a method of testing condensers is given in Fig. 7, an explanation of which follows: Subject the condenser to a 110-volt d-c. charge for five seconds, separate the test points (A) and open switch (B). A condenser in good condition should retain its charge for 10 or 15 seconds and a snappy spark discharge should take place at point (A) when this gap is materially decreased. A leaking condenser will not retain its charge, consequently, no spark will occur when contact points (A) are short-circuited. An open-circuited condenser is more difficult to identify. Observe its effect on the spark produced at the test points (A) when the power switch is closed and the points are slowly separated and compare with the effect produced by a condenser in good condition. A condenser in good condition will reduce the spark to an abrupt blue discharge, but one that is open circuited will not affect it, the resulting long oxidizing flame providing proof of the ineffectiveness of the condenser under scrutiny. A short-circuited condenser will cause the test light to glow when the test points are open. It also causes excessive arcing at the interrupter points of the magneto or distributor breaker points in battery ignition.

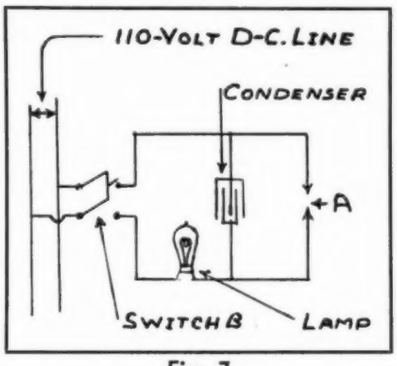


Fig. 7

Loose connections, damaged collector ring insulation, punctured coil insulation, excessive lubrication, and carbon accumulations are all contributing factors to inefficient operation, and any of the foregoing irregularities can be detected only by systematic inspection of all mechanical and electrical mechanisms at regular intervals. Particular attention should be given to brush-gear, which necessarily includes the distributor brush, ground brush, and collector-ring brush. Special consideration should be given to the ground brush, which is an indispensible part of all armature-type magnetos. Failure of this brush to function properly will cause both primary and secondary current to pass to ground through the ball bearings, ultimately damaging the lubricating oil and disintegrating ball races through electrolytic corrosion. Misaligned or worn bearings should be replaced when such irregularities are discovered.

Numerous other ignition difficulties may harass the engine operator; however, careful inspection of all magneto parts and replacement of mechanisms that are inevitably subjected to wear will forestall many forced shutdowns.

Figs. 8, 9, 10, and 11 portray, respectively, polarity determination, remagnetization of magnets, and measurement of magnetic density by spring scale and by magnetometer.

Digression on the principles involved, as depicted in Figs. 8 and 9, would be superfluous; the illustrations are self-explanatory and the results ob-

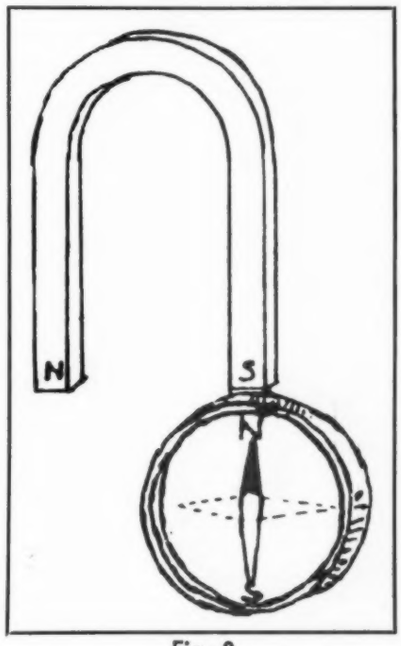


Fig. 8

vious. Magnetic intensity, as measured by the spring scale, is indicated in Fig. 10. The magnet armature with hook attached is suspended from a spring scale. The magnet is attached to the armature and tension applied until the

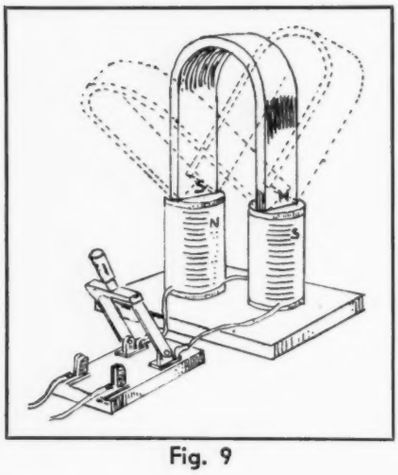


Fig. 9

magnetic bond between the armature and magnet is broken. The scale indication at the instant of break minus the weight of the armature designates the magnetic pull in pounds.

The magnetometer measures actual flux density. It is preferable to the preceding method wherein the actual severance of the magnetic bond is difficult to determine with accuracy. The precision obtainable in testing magnets

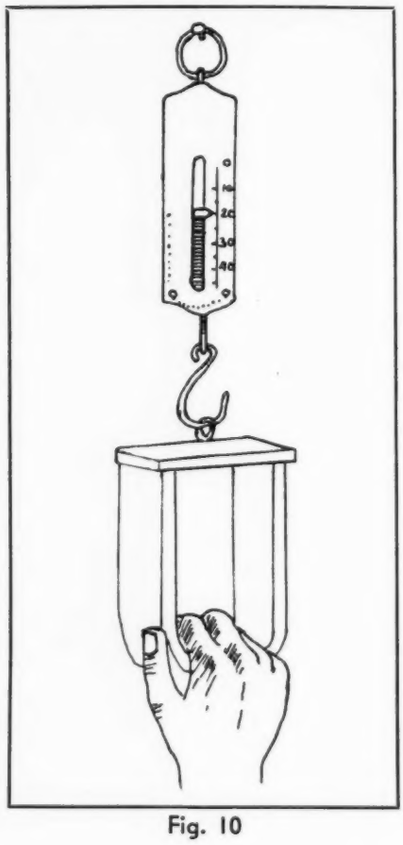


Fig. 10

for field strength and comparative flux density by magnetometer cannot be approached by the spring scale method.

The spark plug, although one of the smallest units of the engine ignition system, performs an indispensible function. Ignition experts and electrical engineers in collaboration with the ceramic chemists have evolved an ignition device that operates satisfactorily under the most adverse conditions. The function of the plug is to insure the regular passage of the spark across the gap without pre-ignition or loss of compression.

General specifications include insulation resistance of not less than 100,000 ohms, voltage necessary to spark production not in excess of 6000, static

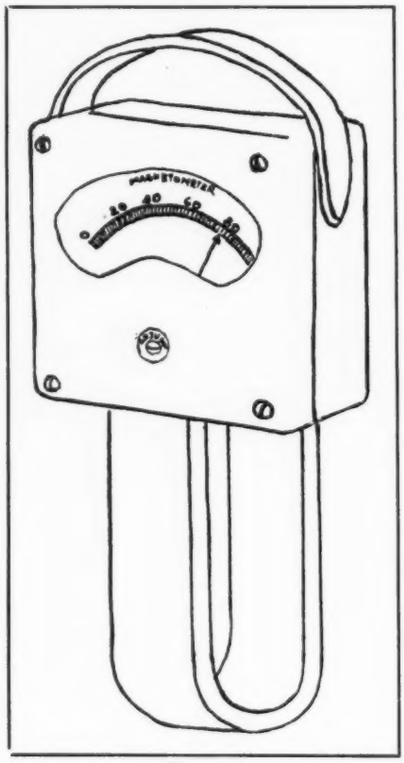


Fig. 11

pressure test approaching but not in excess of 1000 lb. per sq. in., and an instantaneous temperature fluctuation test between atmospheric and 3000 deg. fahrenheit.

Modern spark plugs incorporate a central insulated electrode imbedded in a vitreous ceramic insulator, the outside end of which terminates in a brass cap. The grounded electrode is pressed in place as illustrated in Fig. 12 and welded to insure good electrical contact. The spark gap is dependent upon the engine compression, .015 in. to .018 in. being recommended for high compression engines and .018 to .022 in. for those of lower compression. Excessive openings result in leakage to ground across the coil or magneto safety gap and insufficient gaps cause rough engine operation.

Empirical research has determined the proper location of the spark plug in the cylinder head. Avoidance of excessive temperatures is the paramount

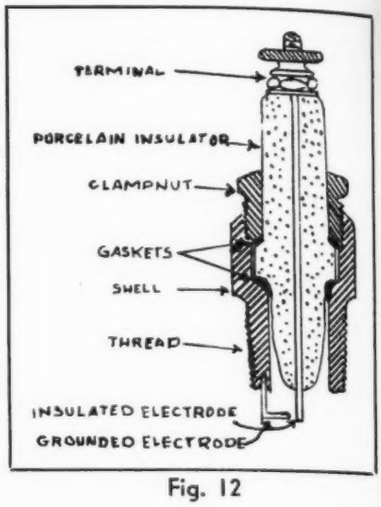


Fig. 12

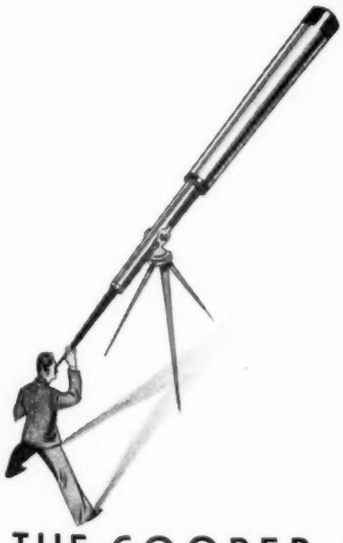
consideration governing such location, as high plug temperatures usually result in pre-ignition, and inversely very low plug temperatures contribute to carbonaceous accumulations on the electrodes that eventually short-circuit the plug. Plugs may now be procured that are adaptable to all engine characteristics, the dimensions of the respective parts being designed to satisfy the different temperature requirements of the wide variety of engines used for industrial and automotive power generation. Battery ignition generally is confined to the automotive field but many modern industrial gas and gasoline engines are equipped with electric starters incorporating a battery and charging generator.

The battery is not used as a source of current for the ignition circuit, this function being appropriated by a high-tension magneto. Desirable features in a battery for ignition and starting service include high discharge rate at maximum voltage, ability to withstand low temperatures, low internal resistance, and rugged structural design.

Several test methods have been evolved to indicate the battery potential and proportionately accumulated charge. A generally accepted test involving the use of a hydrometer to ascertain the specific gravity of the electrolyte is very reliable. The commercial type hydrometer includes a thermometer and tabulated scale that corrects hydrometer indications at the existing temperature to a reading based on a reference temperature, commonly 70 deg. fahrenheit.

LOOK AT THIS ROW OF KW COST-CUTTERS!

FITTS POOL, OKLA. — This row of eight Type GN-8 gas-electric sets, pumps wells and furnishes all necessary current on properties of E. H. Moore, Inc. Each engine is rated 400 hp. at 400 rpm. Three units were first installed; then five more.



A self-sufficient power plant, like this, has these proved advantages:

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105 YEARS OF KEEPING PACE WITH INDUSTRY

The rule in making temperature correction, if a correction table is not available, stipulates that for each 3 deg. fahr. above 70 deg. fahr. add .001 to the hydrometer reading and for every 3 deg. fahr. below 70 deg. fahr. deduct .001 from the hydrometer reading.

For example: If the first temperature at the end of a charge is 120 deg. fahr. and the observed gravity reading is 1.260, the corrected reading is determined as followed:

$120° - 70° = 50°$
$50 \div 3 = 17$ approx.
$17 \times .001 = .017$

Corrected reading,

$1.260 + 0.017 = 1.277.$

Inversely, if the reading at 0 deg. fahr. is 1.210, the actual condition may be found as follows:

$70° - 0° = 70°$
$70 \div 3 = 23$ approx.
$23 \times .001 = .023$

Corrected reading,

$1.210 - .023 = 1.187.$

A corrected reading of 1.280 indicates that the battery is fully charged and should be disconnected from the generating source.

The electrolyte used is a dilute solution of suphuric acid.

Factors governing the care of storage batteries are easy to apply and are indispensable to successful operation. Briefly they are enumerated as follows:

1. Keep the battery clean and dry and apply a light coat of petroleum grease to the cable clamps.
2. Maintain the electrolyte level above the top of the separators by adding distilled water whenever warranted.
3. Do not use any powders or so-called energizing dopes to improve battery operation.
4. Never charge at rates greater than those recommended by the manufacturer.

All battery manufacturers supply instructions governing the care and operation of their various kinds of batteries, which will assure dependable and trouble-free performance.

The component assemblies of modern electric ignition and starting systems will give excellent service if the standard of maintenance follows that generally accepted for the first class upkeep of these devices, and the operator who is cognizant of these facts will reap the benefits of successful operation.

Practical Information on Motor Gasoline Made Public

INFORMATION regarding the characteristics of motor gasolines marketed in cities in different sections of the United States is given in a report just issued by the U. S. Bureau of Mines. Data on distillation range, vapor pressure, octane rating, and other matters of interest to manufacturers of gasoline and designers of automobile engines are given in the report.

Probably the general public has a greater interest in the fuel that goes into the engines of its automobiles and has less accurate knowledge of the material than of almost any other commodity in general use, states the author. A fact often overlooked is that the designer of automobiles and the manufacturer of gasoline must know what kind of gasoline is being sold in all sections of the United States. The automobile designer needs this information so he can provide engines that will take full advantage of the characteristics that have been incorporated in the gasoline by the petroleum refiner. On the other hand, the individual petroleum refiner needs to know the characteristics of gasoline being made by all other refiners so he can make a product that will be within the limits of uniformity required for satisfactory engine operation.

For more than 20 years the Bureau of Mines has reported periodically on analyses of gasolines sold to the general public at service stations throughout the United States. Recently these surveys have been made in coöperation with the Coöperative Fuel Research Committee, which is a joint activity of the Society of Automotive Engineers, the American Petroleum Institute, the Automobile Manufacturers' Association, and the National Bureau of Standards. The paper just issued in this series, Report of Investigations 3374, Coöperative Fuel Research Motor Gasoline Survey, Summer, 1937, compiled by E. C. Lane, may be obtained without cost from the Bureau of Mines, Information Division, Washington, D. C.

New Oil Line Constructed of Unusually Large-Diameter Pipe

MOST oil pipe lines laid in recent years have been constructed of small-diameter pipe, 4-in., 6-in., and 8-inch. Occasionally lines have been constructed of 10-in. pipe. Rarely has pipe exceeding 12-in. diameter been used in construction of oil pipe lines.

The accompanying photograph was taken during the laying of one of the largest diameter oil pipe lines ever constructed. It is a new 16-in. diameter line recently completed for the Sinclair Refining Company near Henrietta, Missouri. The line was laid by the Truman-Smith Construction Company of Eldorado, Kansas, utilizing electric welding equipment supplied by The Lincoln Electric Company, Cleveland, Ohio.

The large-diameter pipe was used to provide a single line, displacing several smaller lines constructed a number of years ago.

Operator welding a joint by the shielded-arc process

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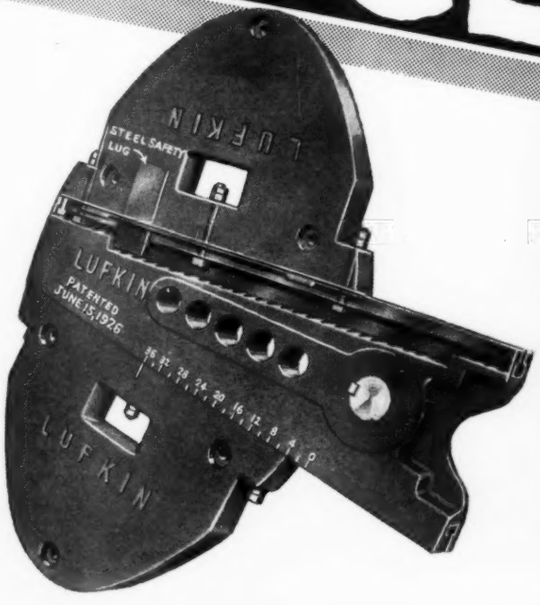

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LUFKIN-TROUT Cranks are **RUGGED.** There is nothing to break—nothing to lose—nothing to "add to" or "take from." Simple in design—flexible in operation—with parts reduced to a minimum.

Rugged and strong, they are good for an hundred years. Like the elephants of India, they literally never wear out.

Lufkin-Trout Cranks are licensed under Patents 1,588,784; 2,071,007; 1,914,387; 2,071,008; 1,599,440; 1,931,861; 2,071,009; 1,979,675; 1,690,376. Others pending.

"LUFKIN UNITS ARE MANUFACTURED AT LUFKIN, TEXAS BY LUFKIN FOUNDRY & MACHINE COMPANY, QUALITY MACHINERY SINCE 1900."

Inexpensive Reconditioning Of Oil Wells

Part 2

By
HENRY E. WINTER
District Engineer, Union Oil Company of California

Shutting Off Water

EXPERIENCE has shown that there is very little progress to be made in attempting to shut off water until its point of entry is definitely located. Before trying to determine the point of entry, however, it is a good plan to wash the perforations, either with a swab cup or one of the various types of perforation cleaners, and then to produce at least 2500 bbl. to insure that the water will be located accurately without risk of its coming in above or below clogged perforations. There may be "back-up" water when the well has been standing wet and idle for some time.

The methods of water location in general use in California are: structural correlations by section; correlation of the salt content, or chemical analysis of the water; distributing mud in the hole and taking thief bailer tests; Dale photo-electric instrument (translucent method); Elliott "Water Witch" (resistance method); and Ennis "Lokate-it" (voltaic method). For the purpose of repair the first three methods may as well be forgotten as success depends on locating exactly the top or bottom point of water entry and these methods do not have the required accuracy. Numerous wells have been lost because, in the course of recementing a few times and then plugging bottom for awhile, no one happened to guess that there might be a hole in the casing.

All three of the electrical methods condition the hole and depend upon bailing or swabbing to lower the static fluid head of the well sufficiently for water to enter the hole.

There are wells in which water has entered at the bottom and migrated up the hole into another low-pressure sand. In one field where attempts to shut off the water had also shut off the oil, the migratory nature of the water was discovered and it then was successfully shut off. For shutting off bottom-hole water in wells not adequately logged, the point of interest is the top of the water entry.

There are four general points of entry for water: (1) bottom; (2) intermediate; (3) water shut-off (commonly called "shoe water"), and (4) hole in the casing. Methods and equipment for use in shutting off water will be determined by the point of entry and the facilities available. Successful work depends very little on "trick" cements; the difficulty is in placing the slurry in the proper place under favorable conditions. There are three commonly-used methods: dump bailers, with or without the addition of a static head of water to force the cement back into the sand; dump bailer and cement shots, and cementing through tubing or drill pipe.

Bottom Water

The dump bailer and hydrostatic head method, sometimes called "lubricating," is the oldest and simplest method of plugging off bottom water. The clean-out bailer is used, a cement dump bottom replacing the clean-out bottom. There are several types of these on the market, either for rental or purchase, as well as many home-made varieties. The glass-bottom type is not very desirable because it is hard to get glass of uniform thickness and because in the larger sizes the weight of the cement may break the glass if the bailer is suddenly slowed down or stopped.

The operation of the bailer first should be checked and the hole then cleaned out and water placed on the bottom. In oily holes the dumping of a little water on bottom before each cement dumping may be beneficial. The bailer should be lowered at a steady rate, not fast enough to trip it when it hits the top of the fluid, and it should not be allowed to hit bottom hard. During dumping of the cement the bailer should be raised slowly at one-minute intervals until it is above the theoretical fill-up, a three-minute interval being allowed when the bailer has been raised about two ft. from bottom during which time it is opened and the cement allowed to drain out.

A satisfactory slurry can be made using 6½ to 7½ gal. of water per sack of cement. Usually two or three dumps can be made on bottom at one time until the hole is filled within 30 ft. of the top of the water entry. From this point to the top of the plug, only single dumps should be made. At the beginning of each dump, water is added at

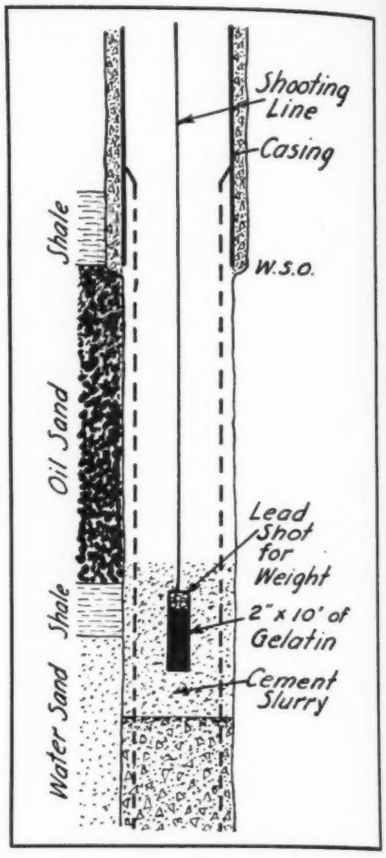


Fig. 1. Cement shot; 2-in. by 12-ft. shell

the surface theoretically sufficient to fill approximately 1000 ft. of hole. This additional hydrostatic head tends to drive the cement back into the water sands and, unless the well has a high fluid level, is preferable to pump pressure, which may force water into low-pressure sands above the point of water entry or down the outside of the perforated casing and outside the cement slurry.

After each batch of cement has set approximately an hour it is advisable to determine whether bridges have been formed by the cement dumped into the hole. Accelerators may be used to reduce the time required for testing but should not be employed if the hole is too hot.

One cement shot procedure that has been successful is to fill the hole within eight or ten ft. of the top of the zone of water entry and to dump enough cement to fill 25 to 30 ft. of casing. Then immediately run a 2-in. by 12-ft. shell within five ft. of the cement and explode it (Fig. 1). A small amount of explosive is as effective as a large amount. Place it half below and half above the top of the water inlet. This will force some slurry under the water cap and some through the perforations to the shale or shell—or will at least break the casing at this

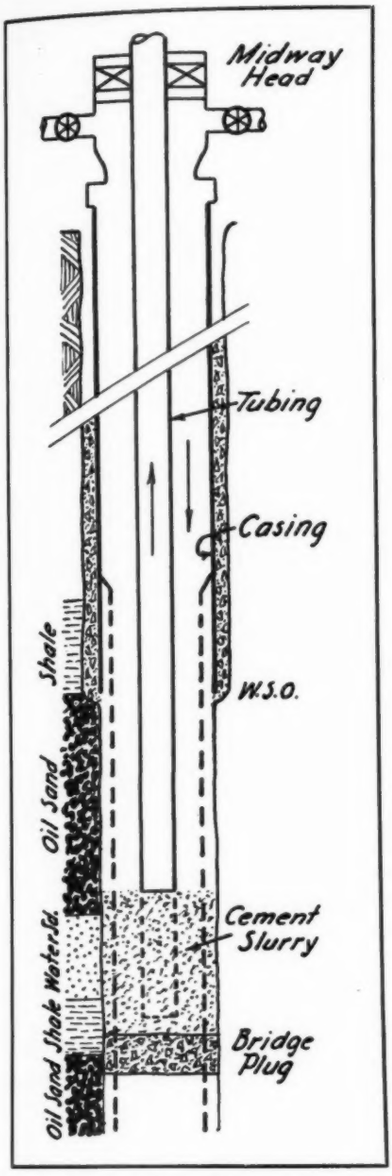


Fig. 2. Intermediate water

point. The hole can then be cleaned and a plug dumped above to strengthen the casing and shut off minor leaks. The explosive sets the cement immediately and no waiting is necessary before cleaning.

Wooden shoes have been driven down on the slurry to act as a piston and force cement through perforations, but in old holes difficulties have usually been encountered. The method is now available commercially in the form of an expanding swab cup at the bottom of the bailer and above the cement dump. Vibration of the slurry to force it through the perforations has also been tried.

Intermediate Water

Both the top and the bottom of zones of intermediate water entry should be determined accurately because the job is not worthwhile unless the zone below the water entry should be worth saving. The chances of success are small using present methods and before the job is finished it will usually be classified as a bottom water shut-off and plugged off above. This type of repair, however, has been performed successfully with the following method (Fig. 2).

A wooden plug is set in the perforated casing approximately 12 ft. below the bottom of the zone of water entry and two sacks of cement in the form of a thin slurry dumped on top. Some of the cement should be puddled through the perforations as the objects are to get a good bond at the surface of the formation and to prevent cement from going into a lower-pressure sand below the bridge plug during the subsequent pressure operations.

Tubing is then run to a point approximately five ft. above the top of the bridge and is packed off in a Midway head with hold-down clamps or any other type of retractable head through which the tubing can be moved while under pressure. With head packing removed, water is circulated down the tubing and up the casing. Then slurry is pumped down and equalized with water displacement until it fills the space inside and outside the tubing to a point approximately 50 ft. above the top of the water entry. The slurry should be made with eight gal. or more of water per sack of cement.

The tubing is pulled up until the bottom is approximately 15 ft. above the top of the water entry and is then packed off in the head. Pressure is applied to the opening in the casing or head to force the cement out through the perforations while the tubing is kept moving through the 15-ft. interval. After the cement has been pumped into the casing or the pressure has built up to 1000 or 1200 lb., the gate on the tubinghead can be opened slightly and reverse circulation established down the casing and up the tubing until the latter is free of cement. The tubing can then be raised a few stands, and later can be used to test the top of the cement. If the desired fill-up has been obtained, the cement can be left to harden; if not, the process can be repeated. The use of the reverse squeeze avoids the risk of washing cement into an upper low-pressure zone.

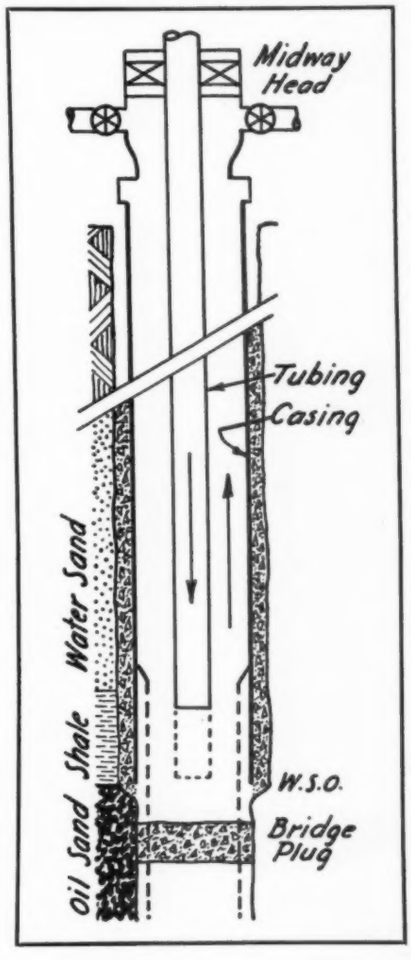
"Shoe Water"

When water develops at the casing shoe or "water shut off" or at the "CP" (cementing through perforations), the best procedure is to set a wooden plug 20 ft. below the shoe and fill with thin slurry to within ten ft. below the shoe (Fig. 3). Tubing is then run to a point ten ft. above the shoe and packed off in a Midway or retractable head. Circulation with water is established and the volume of water that can be displaced in five minutes at 500-lb. pressure determines the amount of cement to use.

The cement is then pumped down through the tubing and displaced with water, the gate in the head being open. When the slurry approaches bottom the gate is closed and displacement continued until the cement is out of the tubing or until the pressure has built up to 1000 or 2000 pounds. The tubing is kept moving up and down during the operation and after the water from the slurry has passed into the formation (requiring four or five minutes) the pressure is released and circulation reversed to clear the tubing of cement and to wash out any cement that may have circulated up the outside of the tubing.

It is good practice to carry a slight back pressure (approximately 100 lb.) while pumping the slurry down the tubing. The first half or two-thirds of the slurry should be thin (eight or nine gal. per sack), but the last part should vary continuously from eight gal. per sack to five gal. per sack for the last

Fig. 3. Shoe water



few sacks. The thin slurry will act as a primer coat for the thicker slurry and form a good strong bond. Pressure should be held as low as possible when pumping the cement.

In some cases the point of water entry will take fluid readily enough to do a straight casing job. If the casing is likely to be bad or line-cut and there is danger of bursting it by using squeezing pressure, a cement retainer is used on the bottom of the tubing. This device seals off the annular space above the bottom of the tubing and relieves the casing above the retainer from squeezing pressures.

Hole in the Casing

If a hole in the casing was caused by some definite accident, it can probably be plugged off by the method used for repairing a leaky shoe. Holes caused by general deterioration or line-cutting can be cemented, but another hole usually opens up. An inside string will save time and money.

Plugging Back to Upper Zones

If, in this operation, the non-producing interval is small (50 to 100 ft.) the bailer dumping methods can be used. If it is greater than 100 ft., however, it will be advisable to lay the plug through tubing or to use a continuous dump bailer. The general tendency in plug-back work is to take in too much formation. The difference between a hole in the ground and a producing well is a matter of careful correlation. Time, care, and money should be spent in correlating and determining just where to perforate. Old wells may not have been cored or electrically logged, but neighboring wells may have been. Electrical logging through casing has been used in some fields to advantage.

If there are two or three strings of casing opposite the zone to be perforated it is usually desirable to salvage the inside string unless it is serving as a protection. Hydraulic jacks should be used for recovering casing. If the results of the perforating show commercial possibilities, all that is necessary is to clean out and test the well on the pump.

When the results of perforating do not look too hopeful, the following factors should be considered: (1) Was the formation perforated only a "long chance"? (2) Are there other, better possibilities higher? (3) Should this perforated zone have made a well, judging by surrounding wells, core records, etc.?

In the first case the perforations can be plugged by dumping cement under hydrostatic head or pumping slurry through tubing. In the second case the cement can be squeezed in as for a leaky shoe in order to force cement away, behind the casing if possible, and to prevent the same water from affecting the next perforated interval as well as to leave a plug to shut off the perforations.

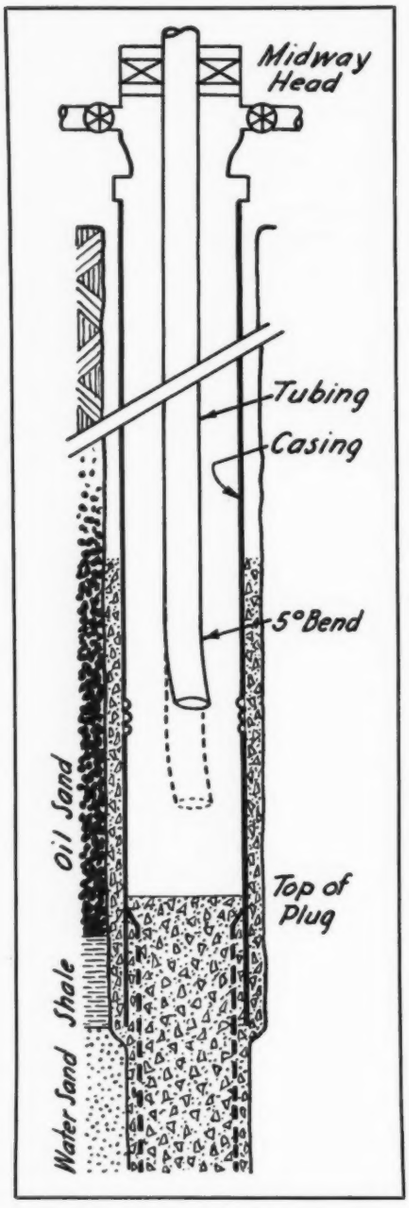


Fig. 4. Bent tubing squeeze or hole in casing

To handle the third case, a new method known as the "bent tubing squeeze" (Fig. 4) has recently been worked out, using slow-setting cement. It is used to squeeze off the perforations, force cement behind the casing, and provide for reperforating by eliminating the necessity of drilling-out cement left in the casing.

The tubing is run to a point within approximately five ft. above the top of the perforations and packed in a Midway or retractable head. The bottom joint of tubing, however, is bent three ft. from the bottom at an angle of approximately five deg. for 2½-in. tubing in 6⅝-in. casing or seven deg. in 8⅝-in. casing, and the plain end of the tubing dubbed-in slightly so as not to hang up on the recesses of the casing collars. The object is to direct the flow of fluid against the side of the casing as well as downward.

Using the same process as is used for repairing a leaky shoe until the excess slurry has reversed out, the packing is then taken out of the head and circulation applied to the tubing, which is then washed down into the slurry three or four times for each joint of tubing used in cleaning out below the perforations. The tubing should be rotated approximately a quarter turn for each washing-down in order to let the bent joint wash the walls.

Abandonments

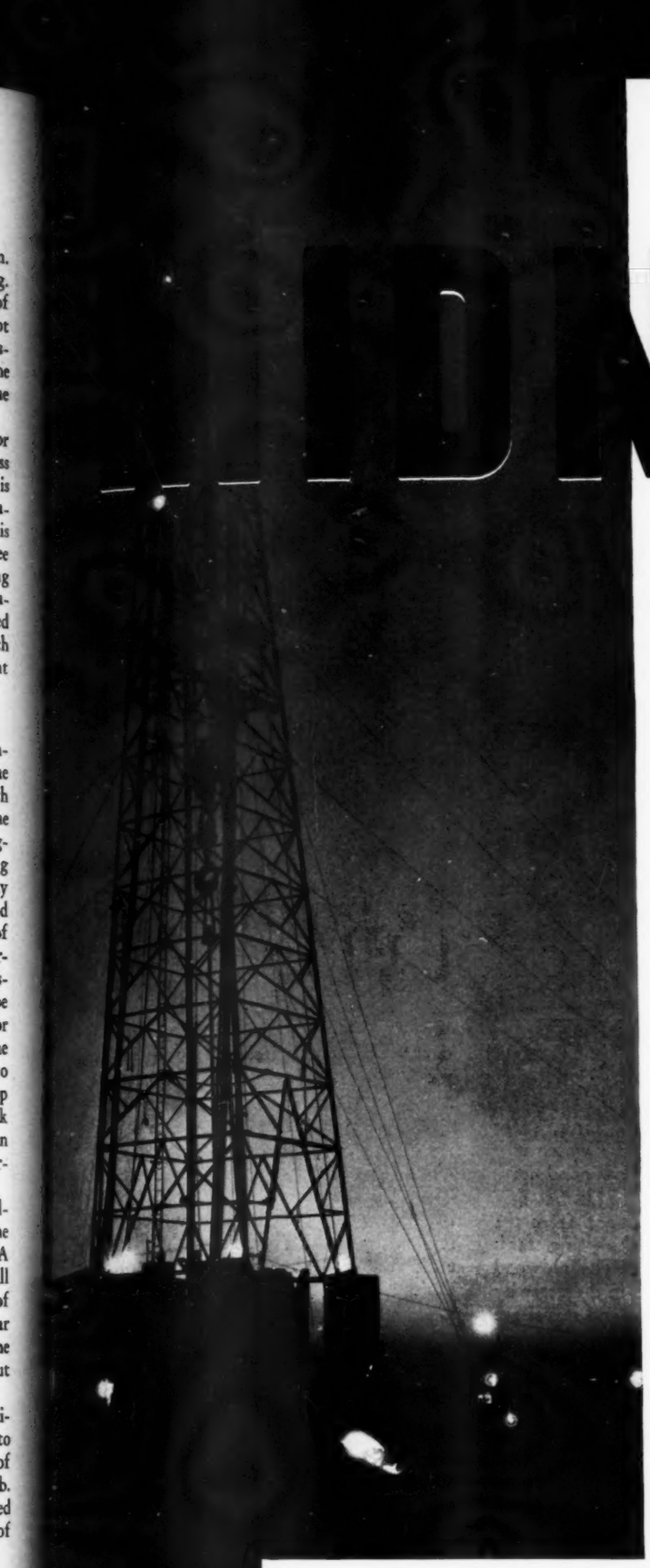
The first requirement in abandonments is to clean the hole and fill the producing horizon or perforations with a solid column of cement opposite the perforations. This is done as in plugging back to upper zones. In pulling pipe, hydraulic jacks eliminate any danger of pulling-in the derrick and injuring workmen. The proper use of hydraulic jacks permits a closer determination of the points where the casing is loose and allows the casing to be parted with a minimum of expense for collar shots. The pressure gauge on the hydraulic jacks should be calibrated to read in tons pressure applied to the top of the casing. It is a good plan to check the formula used for this calculation at 10-ton intervals of stretch to determine how much it is safe to pull.

A good rule to use in placing a collar shot and determining how big the shot should be is yet to be found. A 1½-lb. shot of 80 percent gelatin will usually do the work. The theory of placing the shot is to spring the collar momentarily so that under tension the lower end of the casing will jump out of the collar.

After the casing is pulled, the easiest method for capping the stub is to make a wooden block in the shape of a cork and drive it into the stub. Enough cement slurry is then dumped on the stub to fill 20 or 30 feet of hole.

Conclusion

Complete details of each procedure described in this article have not been given but are described in greater detail in the paper to which reference has been made. The objects of both the paper and this article are to stimulate new ideas, to develop new and better tools and better-trained personnel, and to indicate the importance of repair work, which frequently presents great possibilities for a high return on the investment.



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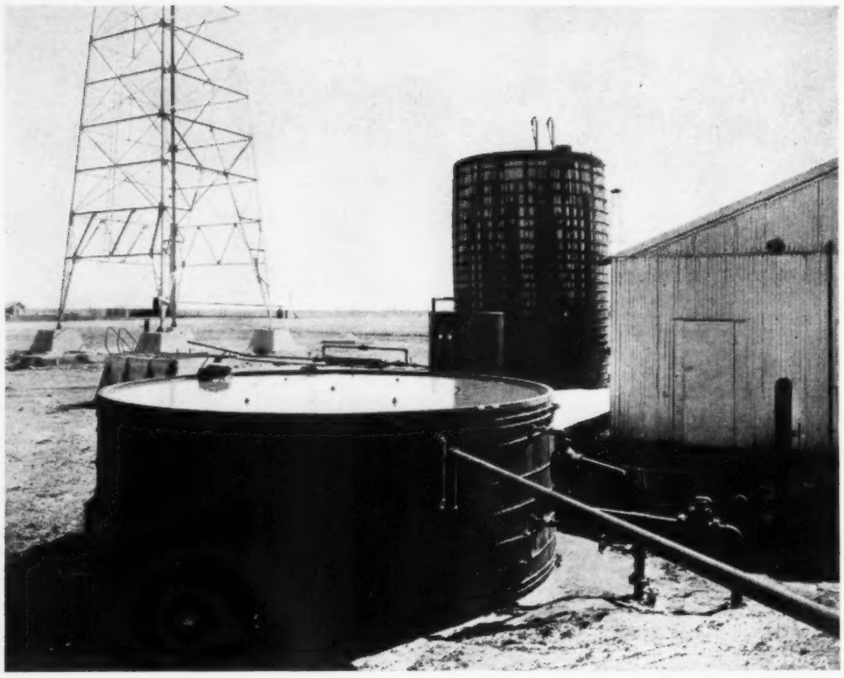

View of the disposal plant taken from on top of the emergency pond dike. In the foreground is the skimming tank with water standing on its water-tight roof. Behind this tank is the steel filter tank and behind that the surge tank. The pump house is partly shown to the right and the disposal well to the left of the picture. On the ground between the surge tank and the disposal well is the Aloxite filter.

Exclusion of air permits simplified treating methods before returning the water to subsurface sand

"Closed System" Makes Effective Salt Water Disposal Plant

By LEO H. TOWERS

DISPOSAL of salt water by returning it to subsurface sands requires engineering skill and design. The main problem in this method is to keep the face of the sand open. To do this the salt water must be treated to remove all suspended matter.

The Pure Oil Company appears to have solved this problem at its disposal plant in the Edmond, Oklahoma, field. By using the "closed system", which prevents air coming in contact with the salt water at any time, this company has been able to process its salt water rapidly and economically. The exclusion of air has reduced corrosion to a negligible amount. Standard pipe has been used throughout the system and examination fails to disclose any evidence of corrosion after a year of operation.

The plant was constructed near the well selected as the disposal well. It is now treating 500 bbl. of salt water per day, although the capacity of the plant is 1500 bbl. per day and the addition of another reciprocating pump and engine would double this capacity.

Equipment housed in the 30-ft. by 40-ft. sheet-iron building consists of a 25/30-hp. gas engine driving a 3½-in. by 6-in., 1500-bbl. plunger pump and a 1½-in., 3000-bbl. centrifugal pump. The engine house is large enough to contain another engine and pump if needed. Outside of the engine house are the skimming tank, surge tank, and filter tank. The water well and an emergency overflow pond complete the system.

The salt water is brought from the lease treaters to the skimming tank through a 6⅝-in. line. The redwood skimming tank is 16 ft. in diameter by 6 ft. high. Top, bottom, and staves are water-grooved. To insure a seal against air, the space above the water in this tank, in the surge tank, and in the lease treating tanks is kept filled at all times with gas at a pressure of four ounces. A 2½-ft. square suction box having leak-proof sides but open at top and bottom surrounds the 6-in. discharge pipe from the skimming tank. The top of the suction box extends almost to the top of the tank and far above the liquid surface. Because of this construction the suction from this tank must necessarily be drawn from the fluid near the bottom. The suction line is swedged from 6-in. to 4-in. diameter outside the tank. The centrifugal pump pumps the water from the skimming tank through the filter tank. The discharge line from the pump swings past the skimming tank, where a kidney float valve inserted in the line is operated by the fluid in the tank. If the water level in the skimming tank drops, the pump discharge line is immediately pinched down, thus insuring against excessive withdrawal.

The filter tank is made from a section of an old separator and is 7 ft. in diameter and 8½ ft. high. The water passes through a 36-in. layer of .35 to .45 mm. filter sand having a uniformity coefficient of 1.70. From the filter tank the water enters a wooden surge tank 16 ft. in diameter by 24 ft. high. Like the skimming tank, this tank is vapor-proof.

The water passes from the surge tank to the input well by gravity or is pumped by the reciprocating pump. At the present time, in handling 500 bbl. of water per day the pump is used about a third of the time. A low-water mercoid switch is provided on the tank to cut off the ignition. A high-pressure mercoid switch on the discharge line from the pump is also connected to the engine ignition.

Just before reaching the well the water passes through an Aloxite filter as a final safeguard. This filter is 9 ft. long and consists of six cylinders of Aloxite 18 in. long. Each cylinder is 7-in. O.D. and 5½-in. I.D. The unit has a capacity of 10,000 bbl. per day of clear water at a 1-lb. pressure differential.

A back-wash system is provided for both the filter tank and Aloxite filter.

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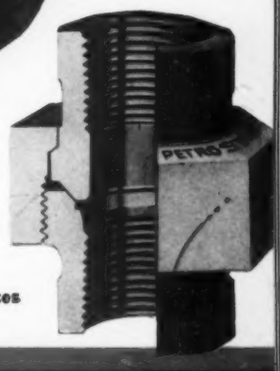

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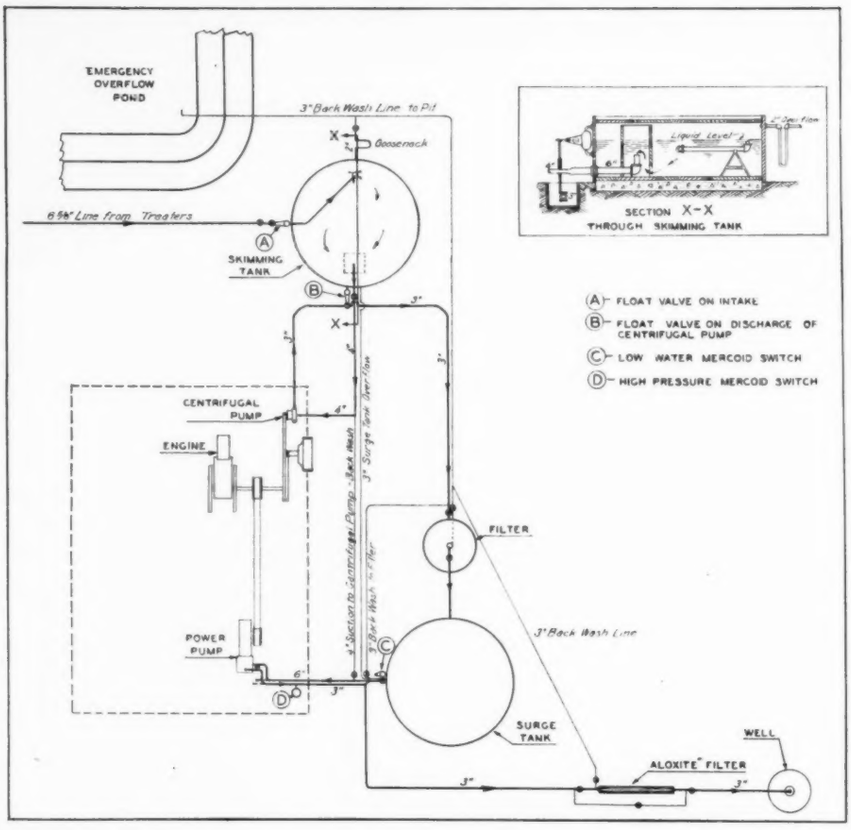

Sketch of the entire disposal system. Salt water lines are shown in heavy lines. Back wash lines are light

In back-washing, the suction and discharge lines are so arranged that both pumps may be used in parallel to obtain additional volume through the filter tank sand. Back-wash blow-off lines and tank overflow lines from all filters and tanks discharge into the emergency pit. Provision is made for excluding air on these lines. At present it is necessary to back-wash at intervals of 30 to 60 days.

Disposal Well Tested

The well selected as the disposal well is on the eastern edge of the producing area and was dry in the Wilcox sand at a depth of 6700 feet. It was plugged back to 2700 ft. in an 8¾-in. hole. A Schlumberger test of the well was made and numerous sands suitable for water-return sands were found above the one that was selected as the most suitable. The sand selected was that at 2550 to 2585 ft., and it contained salt water.

The hole was prepared as follows: It was first reamed to a diameter of 11 inches. A string of 8¼-in., 32-lb. casing was hung and cemented at 2550 feet. Enough cement was used to circulate behind the pipe to the surface. The surface string, consisting of 631 ft. of 13⅜-in. pipe, was also cemented to the surface. To make certain that no cement remained on the sand face a Baker expanding-type underreamer was run in the hole and the sand reamed to a diameter of 14 inches.

Tests of the sand relative to pressures and rate of intake were made using fresh water. The test on the rate of intake under a constant pressure of 225 lb. per sq. in. was as follows:

Time in hours (elapsed time)	*Rate in bbl/day*
0	2400
1	1700
2	1490
5	1325
10	1240
15	1300

Average rates of flow at various pump pressures were as follows:

Pump pressures	*Rate in bbl/day*
225	1225
325	2000
390	2500
450	3000

After the tests were completed the fresh water was pumped from the well to prevent any commingling of different waters.

Very little attention is required in the operation of the plant. The automatic cut-offs on pump and engine and the overflow lines into the emergency pond obviate any danger arising from not having a full-time attendant on duty.

Correct Pulley Diameter for Machinery

By W. F. SCHAPHORST

WHEN measuring pulley diameter for determining machinery belt velocity, do not follow the method shown in Fig. 1, for that method gives merely the outside diameter of the pulley and will result in an incorrect answer if used in making computations.

Fig. 2 shows a pulley and a thick belt. There are two ways in which to measure correct pulley diameter, one being marked "wrong" and the other "right." The "wrong" method is all right if one can measure exactly from belt center to belt center, but it is easier, quicker, and more likely to be accurate to measure the "right" way, as indicated, so that the correct belt thickness will be added to the pulley diameter.

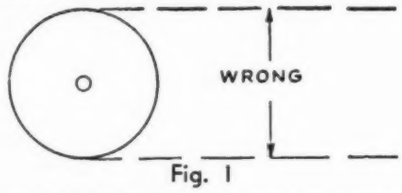

Fig. 1

In other words, always add the belt thickness to the pulley diameter, and the "right" way, in Fig. 2, is the best way to measure the diameter.

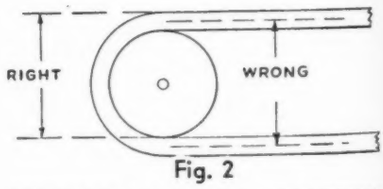

Fig. 2

The method of measuring applies to both driving and driven pulleys. After obtaining the "correct" diameters, use them in your standard formulas. Do *not* use the bare pulley diameter (Fig. 1).

Chemical Utilization of Gaseous Hydrocarbons

By B. KWAL

Part I

Chemicals from refinery gases

IN recent years synthetic products manufactured from gaseous hydrocarbons have attained a high degree of purity. This has been due to the vast amount of research done and also to the perfection of physical methods of separating pure raw materials. Based upon the utilization of the bountiful supply of raw materials made available by the spread of cracking processes in gasoline manufacture, the new industry has grown primarily through the development of improved methods of cracking and of separating chemical constituents of refinery waste gases. In the data on gasoline production by vapor-phase cracking, Wagner[1] has shown that the percent of charging stock gasified is 28 to 35 percent. When the olefin gases are desired, as for chemical synthesis, the gas yield can be increased considerably, as is evident from the results shown in Table I.

TABLE I

No.	Temp., deg. cent.	Gas per 42 gal. oil, Cu. Ft.	Olefins, Percent
1	743	2990	36
2	743	2857	34
3	743	3136	34
4	785	3320	27
5	782	3365	28
6	692	2490	36
7	760	2968	30
8	700	2520	37
9	800	2870	46
10	850	3255	43
11	650	1887	44
12	750	2884	37
13	593	1260	45-48
14	595	1090	45-48
15	597	1175	45-48

Concerning the composition of olefin-paraffin fractions, Brooks[2] has stated that in the case of ethylene-ethane, the ratio of these hydrocarbons is 100 to 51. Brooks found these ratios in his experiments as follows:

Cracking temperature:		
580 deg. cent.	600 deg. cent.	610 deg. cent.
Ethylene-ethane ratio:		
100 to 65	100 to 56	100 to 53

The propylene-propane ratios are as follows:

Cracking temperature:		
580 deg. cent.	595 deg. cent.	600 deg. cent.
Propylene-propane ratio:		
100 to 35	100 to 32	100 to 29

Of the normal butenes present, 2-butene predominates, as is shown by fractionation analyses made by Frey and Hepp[3]. The initial product doubtless is 1-butene, which is rearranged to 2-butene. The butenes made by small-scale experimental cracking, where the cracking time is very short, yield larger proportions of 1-butene. The relative proportion of 1-butene is of considerable importance for certain synthetic applications, though both yield 2-butanol exclusively in the sulphuric-acid-alcohol method; furthermore, the pentene-pentane fraction made by large-scale vapor-phase cracking contains 18 to 25 percent of pentanes. The pentene-pentane fraction made by pressure cracking for gasoline contains 25 to 33 percent pentenes, depending upon the temperature and possibly the time factor in the cracking process employed. The pentene-pentane fraction contains 1-pentane, 2-pentane, trimethyl ethylene, isopropyl ethylene, probably asym-methyl ethyl ethylene and only very small proportions of dienes.

Considering the above-mentioned gas composition, it is seen that the components must be separated in a pure state. For most chemical reactions, there are obvious advantages in using gas rich in olefins. As the first operations were directed towards the production of ethyl alcohol, many methods of concentrating the ethylene were tried. In general the olefin mixtures can be separated by pressure and by treatment with different strengths of sulphuric acid.

The "Société Anonyme d'Explosifs et Produits Chimiques"[4] employs both pressure and cooling to separate a series of liquid fractions from oil gas. Burry and Ollander[5] used the sulphuric-acid treatment and found that with reasonably good surface contact between the acid and the gas 71 percent ethylene content in the gas could be absorbed in two minutes by 95 percent sulphuric acid at a temperature of 60 to 80 deg. centigrade. Ellis[6] first eliminated propylene by treating with sulphuric acid of specific gravity 1.8 at low temperatures, followed by stronger acid at a temperature greater than 60 deg. centigrade. The "C. Still Co"[7] extracted most of the higher olefins and some of the propylene by compressing the gas to 100-200 atmospheres and then scrubbing the gas with 50 deg. Bé sulphuric acid.

With all these methods, however, it is still impossible to effect a complete separation of pure products due to the fact that the absorption process does not proceed to completion under normal conditions. Therefore, proper catalysts have been proposed to promote the absorption of ethylene by the acid. Sulphuric acid and silver sulphate on pumice and certain other substances such as phosphates, have been patented recently as catalysts in this reaction.[8] Damiens[9] has examined the effect of the following factors on the absorption of ethylene: composition of the acid, efficient gas-acid contact, partial pressure of ethylene, temperature of absorption, and the presence of catalysts in the acid. Sulphuric acid of 99.5 percent strength was found to give an absorption velocity of three to five times that of 95.5 percent acid. Englhardt and Lommel[10] have patented the use of silver salt in sulphuric acid for this purpose. Fussteig[11] proposes the use of a catalyst composed of a mixture of silver chloride and cuprous chloride, and a recent patent recommends the use of ferri- and ferro-cyanides.

It is well known that high-temperature cracking operation produces small proportions of dienes. When these are present in substantial proportions they are polymerized in the sulphuric-acid treatment with the liberation of considerable heat and the formation of high-boiling hydrocarbon polymers. In the close-cut butene fraction, made by cracking at a temperature of approximately 600 deg. cent., the butadiene content is about 15 percent. This diene can be removed selectively by treating the hydrocarbon mixture in the cold with a saturated solution of cuprous chloride, the butadiene being subsequently liberated from the acid cuprous chloride compound by heating at a temperature of approximately 55 to 60 deg. centigrade.

Before entering into the details of the separation of components from the gas it would be well to review the

chemical basis of the above-mentioned process. It is known that sulphuric acid is able to absorb the unsaturated gaseous hydrocarbons in such a manner that the acid first combines with the olefins to form definite chemical compounds, which are simultaneously, but more often later, hydrolyzed to give alcohols. Upon treating a mixture of olefins and paraffins with sulphuric acid, a portion of the dialkyl sulphate formed passes into the residual naphtha, usually requiring redistillation of the residual naphtha before blending.

The higher dialkyl sulphates are miscible with hydrocarbon solvents and it is known that cracked gasoline, refined by treating with concentrated sulphuric acid, always contains dialkyl sulphates that are decomposed upon being redistilled. Large yields of dialkyl sulphate are favored by the solution of excess olefin in the monoalkyl sulphate-acid mixture, which in the case of ethylene, is readily effected by application of pressure. Thus, using 98 percent acid at a temperature of 80 deg. cent., ethylene under a pressure of approximately 40 atmospheres gave 80 percent of two mols ethylene combined in 50 minutes. In the case of the pentenes the excess of olefins is readily soluble in the monoalkyl sulphate-acid mixture and reacts at 20 deg. cent. to form yields of diamyl sulphate.

In addition to the above-indicated reactions, secondary reactions, such as decomposition, carbonization, and formation of sulphur dioxide and tar are possible under certain conditions. These occur with the increase of temperature and concentration of acid. When the concentration of acid and its temperature are too great, polymerization of propylene and the higher olefin homologs may be a serious loss during this absorption process. This polymerization takes place in such a manner that in a mixture of olefins one olefin may polymerize and couple with it another olefin that by itself is not polymerized. For example, when butadiene is polymerized by sulphuric acid in the presence of normal butenes, viscous high-boiling polymers are formed in about twice the proportions of the butadiene present. Thus it is seen that while such a polymerization of gaseous hydrocarbons gives a good yield of motor fuel under certain operating conditions it must be avoided in the absorption process. As mentioned previously, the action of the sulphuric acid on olefins results in the formation of alkyl sulphates, these being stable in the presence of water at normal temperatures. When these alkyl sulphates are heated with water they hydrolize easily, this hydrolysis being promoted by the hydrogen ion. The effect of excess sulphuric acid on the hydrolysis of alkyl sulphates in the diluted acid product obtained in large-scale practice is very marked, being more rapid when excess free sulphuric acid is present.

Let us now describe the behavior of the unsaturated hydrocarbons during the absorption process with sulphuric acid. Curme[12] proposes to produce diethyl sulphate commercially in this manner, using pure ethylene and volatilizing the diethyl sulphate from the acid mixture in a stream of excess gas. Plant and Sidgwick[13] have also described the formation of diethyl sulphate, and Maimeri[14] produces it by absorbing ethylene in concentrated acid at a temperature of 65-75 deg. centigrade. Brooks[15] has stated that the absorption of the ethylene is greatly accelerated by application of pressure, the rate being roughly a linear function of the pressure. The use of pressure within the range of 18 to 35 atmospheres is particularly convenient when the propylene and higher boiling hydrocarbons are separated by fractionation. Of course, the rate of absorption of ethylene by sulphuric acid depends to a large extent on the surface contact of the acid and the gas, and the agitation of the acid. Hydrolysis of the sulphuric acid in which ethylene has been absorbed results in the formation of ethyl alcohol. Synthetic ethyl alcohol, as made from properly purified gas, is purer than ethyl alcohol made by fermentation.

As far as propylene is concerned, it is known that this hydrocarbon can be transformed into isopropyl alcohol. The first account of the production of isopropyl alcohol from cracking-still gas was published by Ellis.[16] This alcohol closely resembles ethyl alcohol in its physical properties and solvent value. For the manufacture of isopropyl alcohol a stabilizer overhead gas is now employed, this gas containing about 20 percent propylene. According to the method of operation devised by Lebo[17] such a gas is treated with sulphuric acid in a special tower provided with cooling coils and in the presence of a proper absorbent oil.

By using low pressures in the reaction tower its capacity increases considerably. The absorption is carried out until the acid reaction product contains a substantial proportion of diisopropyl sulphate. After separating the neutral oil and acid product, the latter is subjected to hydrolysis, and distilled continuously with steam. A small proportion of isopropyl ether is normally obtained. On rectifying the crude isopropyl alcohol, isopropyl ether is obtained in the lower boiling fraction. When the propylene-propane fraction is liquefied, this fraction contains 80 percent propylene and 20 percent propane.

As in the liquid conditions this fraction may be agitated with acid for any length of time desired, it is possible to carry out the reaction with sulphuric acid of 80- to 85-percent strength. Brooks and Cardarelli[18] have stated that when carrying out this absorption process under pressure and at a temperature between 15 and 20 deg. cent., using 85 percent sulphuric acid, the product is largely diisopropyl sulphate and the formation of polymers is entirely avoided.

Isopropyl alcohol plays a very important part in the chemical industry. It is produced mainly in three grades: crude for denaturating purposes, isopropyl alcohol of 91 percent strength, and anhydrous; a product suitable for perfumers' use is also manufactured. Isopropyl alcohol can be dehydrated more easily than ethyl alcohol. A brief digestion with caustic soda and subsequent distillation yield the anhydrous alcohol. Isopropyl alcohol is a satisfactory anti-freeze solution, miscible in all proportions with water; where temperatures below 0 deg. fahr. are encountered the isopropyl - methanol blend in the proportion of 65 to 35 is satisfactory.

Furthermore, the isopropyl alcohol in the anhydrous form, which is easily obtained, is useful for the dehydration of nitrocellulose. It is also used for drying and preserving animal and vegetable tissues, for drying proteins, sugars, etc.

Let us now discuss the butyl alcohols. As known, the butene fraction contains isobutene and the normal butenes. By the action of the dilute sulphuric acid, isobutene can be transformed into tertiary butyl alcohol. Many writers believe that tertiary butyl alcohol is decomposed on warming with sulphuric acid as dilute as 0.02 normal, and early in this development it was thought necessary to neutralize the diluted acid product to obtain the tertiary alcohols. Brooks [19], however, has found it possible to recover from solutions containing 30 to 40 percent sulphuric acid 80 percent of the tertiary butyl alcohol present by rapid continuous distillation with steam in a column.

The treatment of gaseous olefin mixtures obtained from the cracking of oils, containing butenes and other higher molecular gases, first was described by Ellis and Cohen[20]. In such unsaturated gases there are, in addition to the tertiary butyl alcohol, also the secondary butyl alcohol. These two

(*Continued on Page 62*)

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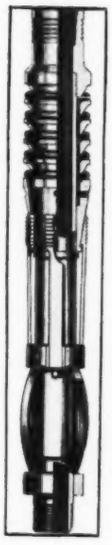

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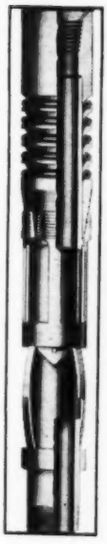

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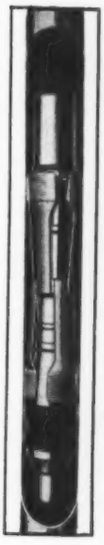

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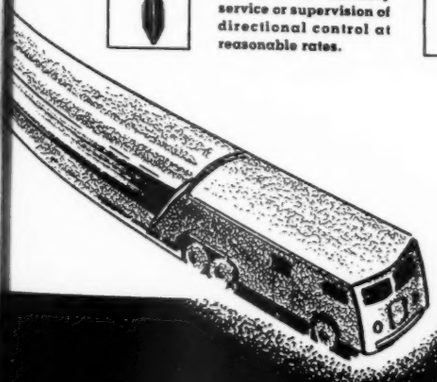

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(*Continued from Page 58*)

alcohols, of course, should be separated one after another. Weizman and Legg[21] recommend for this purpose the use of 75 percent sulphuric acid; however, there are different opinions in this matter. For example, Taveau[22] recommends the use of 85 percent sulphuric acid at the temperature of less than 30 deg. cent., and Engs and Moravec[23] use 90 to 95 percent sulphuric acid for the same purpose.

Temperature plays a very important part in the absorption process, however, but an increased concentration of sulphuric acid and high percentages of butenes in the hydrocarbon treated make temperature control increasingly difficult. According to Brooks[24], when the normal butenes are in the liquid phase they can be sulphated very rapidly without polymerization by treating with sulphuric acid of 70 to 75 percent concentration and at a temperature of 20 deg. centigrade.

When diluted with large proportions of saturated hydrocarbons, higher acid concentrations are a great advantage. In the butene fraction of a vapor-phase-cracked gas certain butadiene content is present. This butadiene must be removed from this fraction and, as mentioned, cuprous chloride is used for this purpose. Brooks proposes the following method of butadiene isolation from the butene fraction: the butene fraction is agitated with a thin slurry of cuprous chloride in a 10 percent solution of ammonium chloride in a copper-lined vessel. The butenes and butane are allowed to boil off, being condensed then under a few lb. pressure, and the double compound is decomposed by heating to a temperature of 55 to 60 deg. cent., and condensing the liberated butadiene. The same investigator has found that, contrary to the statement of others, isobutane can be removed selectively by 65 percent sulphuric acid at 10 to 15 deg. cent. without polymerizing the butadiene.

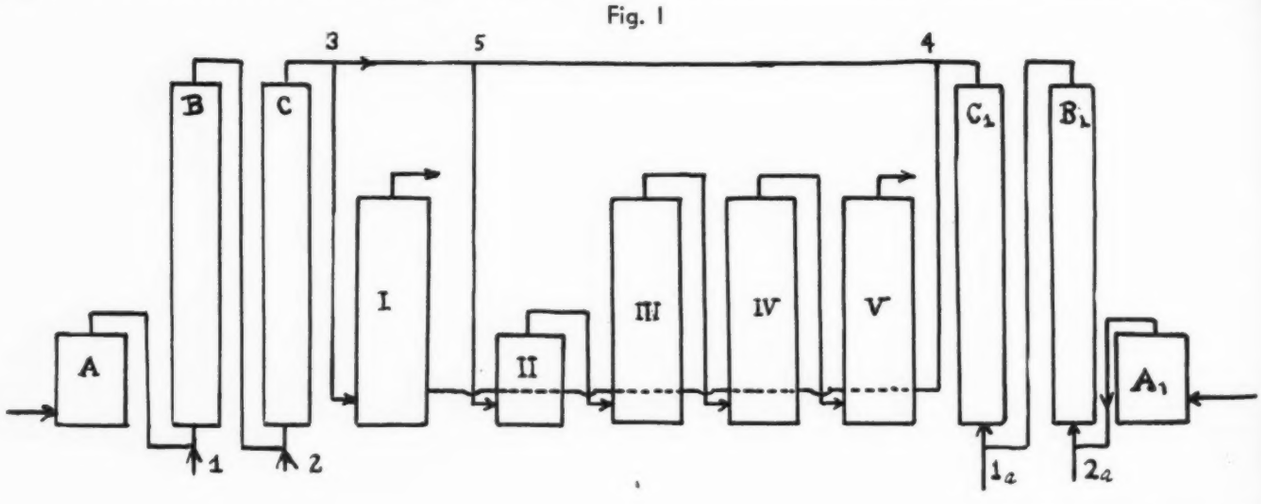
Regarding the place of butyl alcohols in the chemical industry, the secondary alcohol, the so-called butanol-2, is the raw material for the production of the secondary butyl acetate and methylethylketone. Tertiary butyl alcohol, once a chemical curiosity only obtainable by difficult synthesis, has been produced in quantity and employed as a solvent, as a raw material to produce iso-octane, a standard anti-knock engine fuel, and as a raw material for synthetic musk, etc.

It is very important to mention here that the butadiene also plays a very important part in the chemical industry, because it can be polymerized to a rubber. By condensing with maleic anhydride good yields of tetrahydrophthalic anhydride can be obtained and as a result a series of high-boiling esters used in the lacquer industry can be made. For example, the tetrahydrophthalic anhydride can also be condensed with glycerine and glycols to a series of hard, transparent, nearly colorless resins similar to the well-known glyptal resins.[25] It can be seen from the above that when the butenes are properly purified, as by the successive removal of isobutene and butadiene, the remaining butenes can be successfully sulphated under a fairly wide range of conditions.

It has been stated that the gas obtained by vapor-phase cracking also contains certain amounts of pentenes. The pentenes in the five-carbon fraction, made by pressure cracking, constitute about 30 percent; however, these pentenes exist in several forms, these being transformed into secondary and tertiary amyl alcohols. The only pentene that has the tendency to polymerize is iso-propyl ethylene. The sulphate of this alcohol reacts with an olefin of this type rapidly, resulting in the polymerization phenomenon. Pure normal pentenes, when treated with sulphuric acid of 80 to 90 percent sulphuric acid content and at temperatures of 15 to 20 deg. centigrade, give nearly theoretical yields of secondary amyl alcohols. Likewise, asym-methylethylene and trimethylethylene, with a more dilute acid, give nearly quantitative yields of tertiary amyl alcohols. When a pentene-pentane fraction reacts with a small proportion of sulphuric acid, the dialkyl sulphate formed is distributed between the acid reaction mixture and the pentane, being miscible in both. The amyl alcohol made by the absorption process consists chiefly of pentanol-2 with small amounts of pentanol-3. Secondary amyl alcohols are used chiefly in the form of acetates as solvent in the lacquer industry and for the manufacture of methyl and diethyl ketones, the latter being one of the newer commercial developments in lacquer solvents.

Concerning the tertiary amylene alcohols, it has been stated that the proportion of the trimethylene ethylene, which yields the tertiary amyl alcohol, is so small that the selective removal of this pentene by dilute acid is seldom carried out. In view of what has been stated, it is seen what great difficulties are encountered in the absorption process of gases by means of sulphuric acid. Fussteig[26] shows that it is possible to carry out by means of his new method an exact separation between the normal, secondary, and tertiary alcohols. As known, iso-butylene has a higher solvent power than the normal and tertiary butylene. Similarly, the trimethylethylene has a higher solvent power than the iso-amylene. According to these properties Fussteig has evolved a method in

Fig. 1



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which the sulphuric acid is used in four different concentrations.

The apparatus for this purpose consists of four cylindrical vessels, the first being filled with sulphuric acid of 45 deg. Bé., the second being filled with sulphuric acid of 50 deg. Bé., the third with sulphuric acid of 60 deg. Bé., and the fourth with sulphuric acid of 66 deg. Baumé. In each of these vessels quite another temperature exists; in the first the acid shows a temperature of 30 deg. cent., the second vessel shows a temperature of 40 deg. cent., the third 50 deg. cent., and the fourth vessel has a temperature of 60 deg. centigrade. As a catalyst a mixture of silver chloride and cuprous chloride is used. The gas being cracked, after butadiene is removed, passes successively through the four vessels in which the separation between the tertiary and secondary alcohols occur. This method requires the use of very great surfaces, necessitating the construction of great absorption towers; besides, it must be admitted that the ethylene cannot be completely isolated so that it will be distributed in the acid of each absorption tower. All these difficulties Fussteig has overcome by using activated carbon in connection with the acid absorption process. For this reason Fussteig[26] recommends the operating process, the flow diagram of which is shown in Fig. 1.

The gas is first directed to the vessel A where its complete dehydration takes place. Then it passes the tower B, which is filled with quartz particles. After having passed this tower, it is directed to tower C, which is filled with activated carbon. This tower is provided with a steam coil at the bottom, to keep the tower temperature at 40 deg. centigrade. In this tower all olefin homologs are adsorbed by the activated carbon, while the saturated hydrocarbons and ethylene continue on their way, and pass the absorption vessel I.

Of course, it is necessary to submit the outlet gas from the tower B to a continuous analysis, and in event the outlet gas shows even traces of other olefin homologs it proves that the activated carbon is saturated by olefin hydrocarbons. In this case it is necessary to close the flow of the gas to the towers B and C, combining it with the gas entering towers B_1 and C_1, in which the same process occurs. Following this operation steam is directed into towers B and C to remove all adsorbed olefins from the microscopic channels of the activated carbon. The gaseous olefins thus delivered are allowed to pass vessel II filled with cuprous chloride in which the separation between butadiene and other olefins takes place. After the butadiene is isolated the gas enters the absorption vessels III, IV, and V, which are filled with sulphuric acid of the above-mentioned concentrations.

The steam is directed to the towers until the outlet gas no longer contains olefins. The activated carbon is then treated with superheated steam at a temperature of 250 deg. cent. to regenerate it. Viewing this discussion in the light of the above, we come to the conclusion that this method can be considered as economic and practical, as tertiary and secondary alcohols are isolated separately. In addition to these advantages, another is the possibility of producing pure ethylene that can be transformed into different chemicals. The chief chemical intermediate obtained from ethylene is the chlorhydrine from which ethylene oxide and ethylene glycol can be readily prepared. The use of ethylene glycol in explosives and anti-freeze agents is well known. Ethylene chlorhydrine vapor has been found to break the dormancy of sugar maple and chestnut seedlings. Furthermore, many solvents, especially for lacquers, are now prepared from ethylene glycol. For example, diethylene dioxide (Dioxane) is a solvent for ester gums, vinyl resins, shellac, and cellulose acetate. The use of $\beta\beta'$-dichlorethyl ether (Chlorex) as a selective solvent in the refining of lubricating oils is of interest.

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A.P.I. Sees Little Danger of Oil Depletion

LIKE those who predict the end of the world on a certain date and are disappointed when finis is not written, prophets who have predicted the end of America's oil reserves are likely to be proved wrong.

No sooner had the first shallow wells been opened in Pennsylvania than the oil seers appeared. In 1889 David T. Day, head of the U. S. Geological Survey, solemnly declared that the nation's oil would last only a few years. That was in the good old horse and buggy days. At that time the prediction that millions of horseless carriages would flit across the nation's roads, consuming more than 20,000,000,000 gal. of gasoline in a single year, would have been regarded as downright silly.

A quarter of a century later, in 1915, the U. S. Geological Survey issued a report estimating oil reserves at 7,500,000,000 barrels. Yet during the next 20 years nearly twice that amount — 14,260,000,000 bbl. — was taken from the earth. In 1921 the same agency reported 9,000,000,000 bbl. available, and in 1934 reported 13,250,000,000 barrels.

In 1935 the American Petroleum Institute's Committee on Petroleum Reserves estimated known reserves at 12,177,000,000 barrels. Since that time more than 3,300,000,000 bbl. of oil have been brought to the surface. Despite the enormous use of petroleum in this automobile age, the committee now estimates oil reserves at more than 15,500,000,000 barrels. This is the highest in history.

The new estimate takes into consideration only the proven areas. It is based upon present known production methods, which are able to obtain only part of the oil in the ground, but are improving.

The end of oil apparently is not yet in sight, despite the dire predictions that have been made continuously since the first oil well was opened in America. The gasoline buggy probably will wind its merry way along the highways for centuries. Besides resources of liquid bituminous and other materials, the United States has immense resources of bituminous shale. As yet untapped, these probably would meet the fuel needs of motor vehicles for centuries. It is also possible to make gasoline from soft coal, of which there are immense deposits in this country. This source of gasoline will endure for many centuries. There are those who believe the United States reasonably can expect no serious shortage of gasoline for a thousand years.

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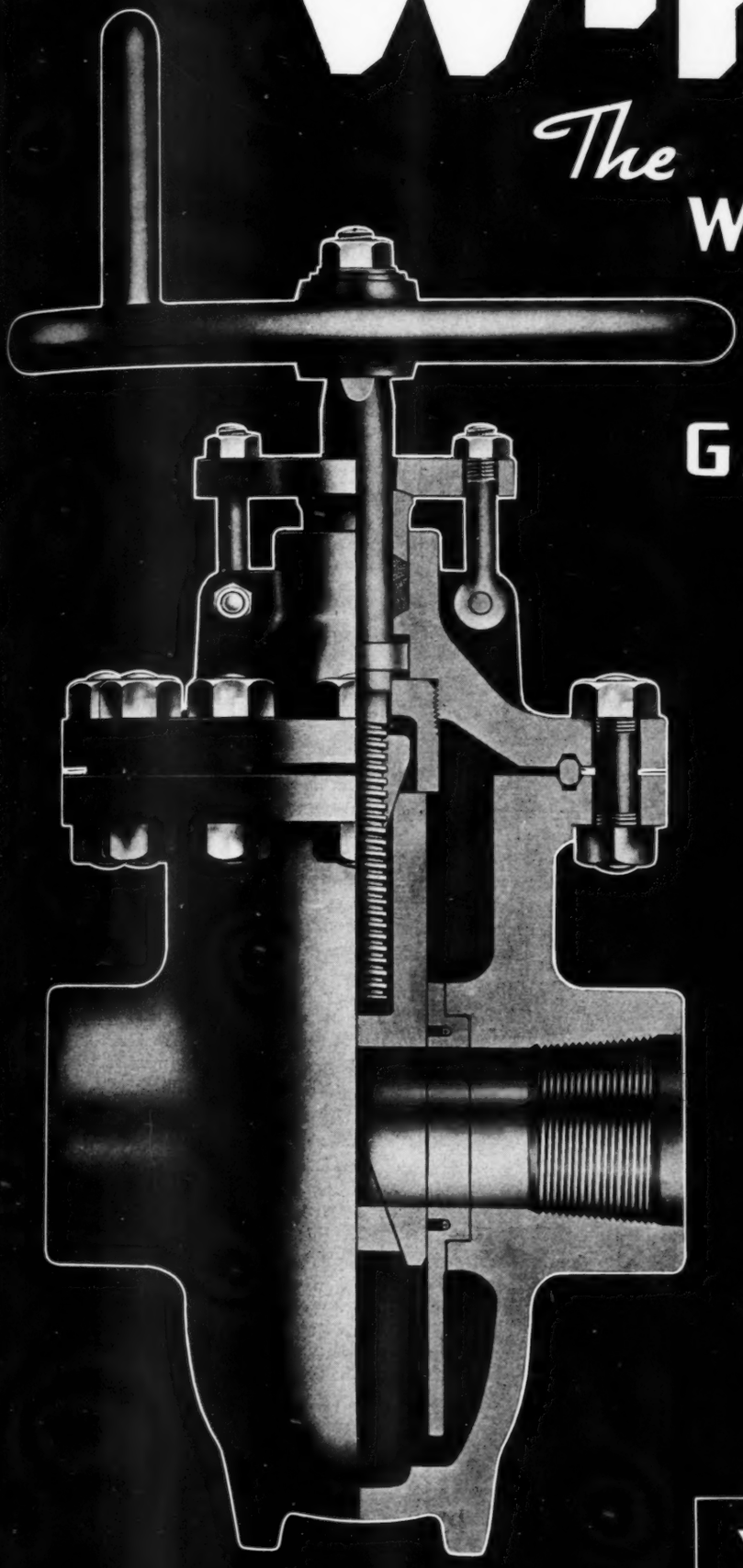

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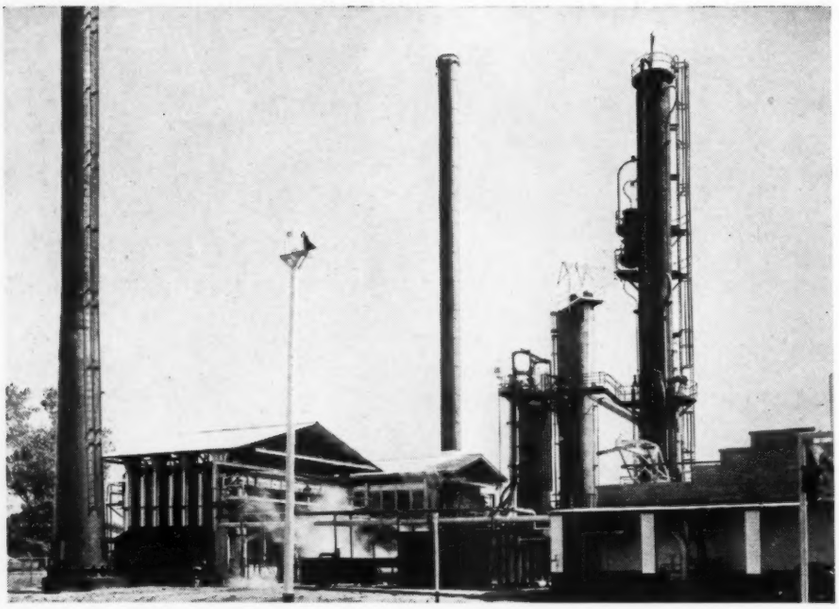


Sunray Oil Company's Dubbs cracking plant at Allen, Oklahoma. New furnace is shown at left

By
J. C. ALBRIGHT

•

Addition of a double-end fired heater, a new flash chamber, a gas-engine-driven hot-oil pump, and other accessories necessary for full-flashing, two-coil operation has resulted in increased efficiency

Remodeling of Cracking Equipment Increases Refinery's Capacity

DURING 1937 the Sunray Oil Company increased the capacity of its refinery at Allen, Oklahoma, by adding to and rearranging its Dubbs cracking unit equipment. The unit, erected a few years ago, consisted of a single furnace, which was used as a heater for heavy oil only, a reaction chamber, and a combination flash and fractionating column.

The change-over was begun in the spring of 1937 and completed during the latter part of June, and the cracking plant was placed on stream July 4th. The addition to the cracking plant of a double-end fired heater, a new flash chamber, a new gas-engine-driven hot-oil pump, and other accessories necessary for full-flashing, two-coil operation increased the capacity of the unit approximately 100 percent.

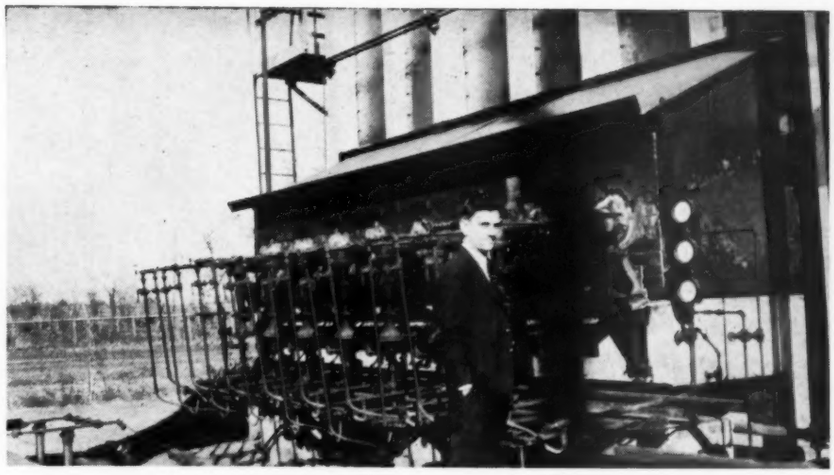
The original single-coil furnace, built when the cracking plant was erected a few years ago, is now serving as the light-oil heater, and the old hot-oil pump has been placed in service to handle the light-oil stream from the fractionating column to the light-oil cracking furnace. As it was necessary to install a separate column for flashing the cracked material from the reaction chamber, the combination flash and fractionating column was rebuilt at the time the new equipment was installed, so that it now serves only as a fractionating column from which the fuel for both furnaces is obtained.

Numerous processing combinations are possible at the refinery. For instance, fresh crude sometimes is pumped through a vapor-to-charge heat exchanger and heated to a temperature of approximately 285 deg. fahr., the charge flowing directly to a large horizontal drum where salt and other foreign matter is settled. From there the crude can be directed to the older skimming plant for reduction, or it may be passed to a residuum heat exchanger and then processed in the column of the skimming plant without utilizing the furnace of that unit. Sufficient heat is obtained from the residuum to permit production of the desired volume of straight-run gasoline before the crude is cracked. Again, the crude can be introduced into the cracking system without previous treatment and cracked in its entirety.

Main fractionating column showing side-cut stripper near top where distillate is removed

When following the first method topped crude is charged directly to the flash chamber of the cracking unit, where it enters the tower immediately above the second from the top side-to-side pan. Here a large part of the more volatile constituents is vaporized by heat obtained by direct contact with ascending vapors passing from the reaction chamber through the flash column. If conditions of operation of the cracking plant warrant introduction of a cooler oil to the upper section of the flash chamber, the charge, consisting of topped crude, flows through an inter-

West side of double-end fired furnace



mediate cooler to reduce the temperature sufficiently to give the desired results in that column.

Approximately 3200 bbl. of fresh Allen crude is processed daily by the refinery. Gravity of the topped crude averages 25.8 deg. A.P.I. Straight-run gasoline having an end point of 387 deg. fahr. is produced and the pressure distillate averages 394 deg. fahr. end point. The combined feed from the base of the fractionating column is handled by a 5½-in. by 18-in. horizontal gas-engine-driven hot-oil pump, working against an average back-pressure of 600 lb. gauge. This feed has a normal gravity of approximately 19 deg. A.P.I. and is pumped directly to the new furnace for cracking. This unit is a double-end fired heater, using gas as fuel. Temperatures are uniform throughout the combustion chamber.

The material heated in the light-oil furnace for cracking is taken from a draw-off section in the fractionating column, and has an A.P.I. gravity of approximately 24.5 degrees. The pump that handles the light-oil charge was used for pumping cracking stock when the plant was originally built. It has a 5-in. bore and 18-in. stroke, and is driven by a twin-cylinder, 2-cycle gas engine. Inasmuch as the gas engines are of the same size and type, parts for one can be used interchangeably on the other, thus reducing the number of spare parts that must be stocked.

The light-oil charge passes directly to the heater, which contains 30 4-in. O.D. by 3½-in. I.D. tubes 30 ft. in length, arranged as a convection bank, 34 3½-in. by 2¾-in. roof tubes 30 ft. in length, and 22 3½-in. O.D. by 2¾-in. I.D. floor tubes 30 ft. in length. All tubes in this heater are made of carbon steel, the use of alloy steel being considered unwarranted, as no indication of corrosion has ever been observed.

The two streams of cracked material flow through separate lines to the reaction chamber. The outlet pressure of the light-oil furnace, as well as that of the heavy-oil furnace, is governed by the pressure in the reaction chamber. The heavy-oil transfer temperature is maintained at approximately 750 deg. fahr., whereas the light-oil transfer temperature averages 990 deg. fahrenheit.

An average pressure of 275 lb. is maintained automatically on the reaction chamber by an instrument-controlled outlet valve on the line just outside the discharge connection. A master gate also is installed in this line to supplement the automatic valve and protect the unit if the controller should be damaged. The material flowing from the reaction chamber is mixed with low-pressure cooling oil in the usual manner, and the liquid that is arrested while being cracked flows through a 1-in. line to the base of the flash chamber. A welded tee inside the chamber directs the flow of hot oil and vapors against a wear plate welded to the inside of the vessel.

This chamber is 8 ft. in diameter by 48 ft. high and is equipped with eight side-to-side cast-iron pans, below which is the draw-off section for the topped crude charge. The column is held at a temperature of 814 deg. fahr. at the top, the temperature of the draw-off section being approximately 830 deg. fahrenheit. Heavy fractions leave the chamber through a 10-in line, flowing to the base of the fractionating chamber. The vaporized material flowing through the flash column leaves the top of the vessel through a 12-in. line and enters the fractionating column at a point just above the liquid entrance flanged connection.

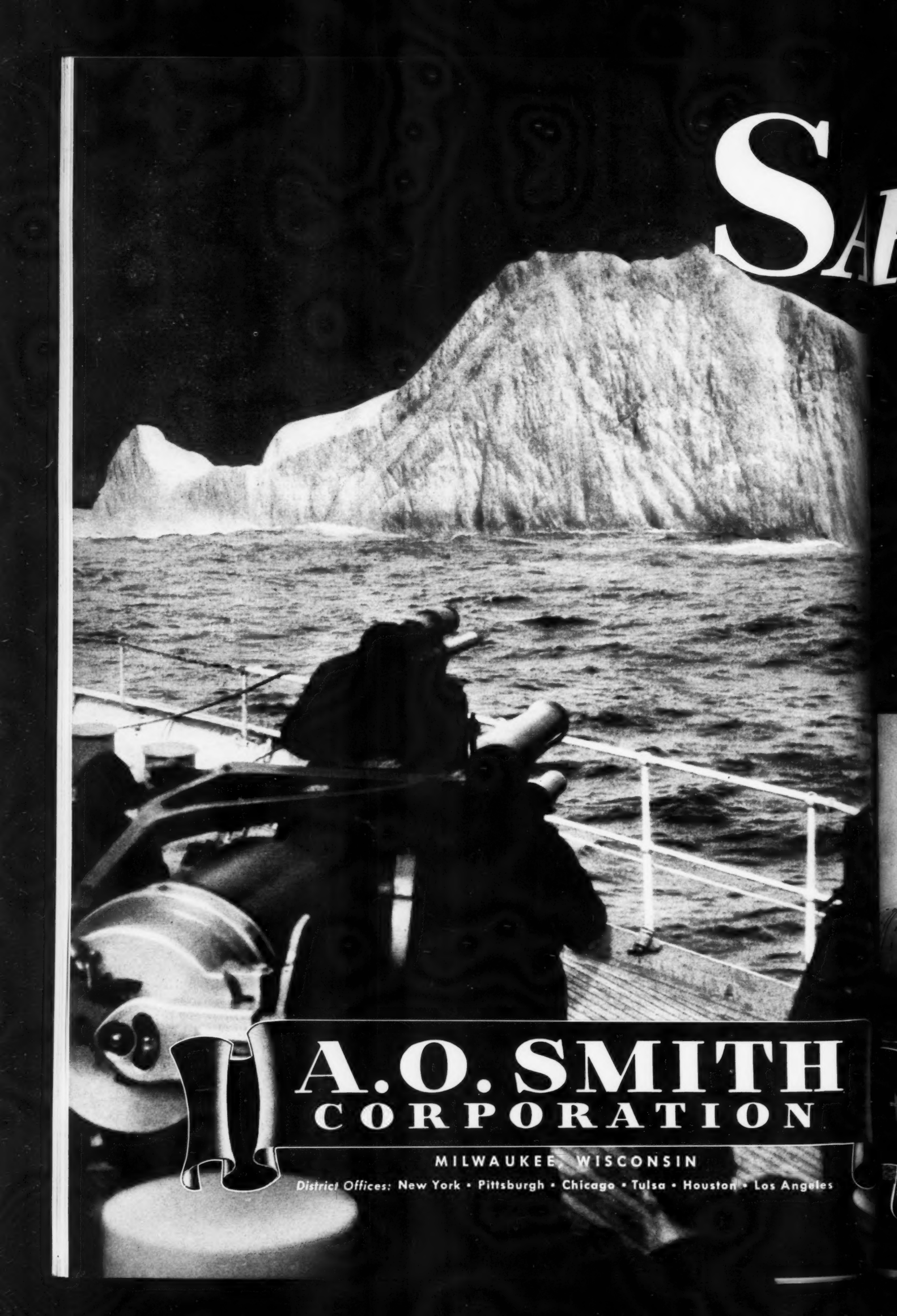
The fractionating column, originally designed as a combination tower for fractionating the cracked vapors and for receiving the charge from the reaction chamber, is now equipped with four fractionating trays to control the flow of vapors entering with the liquid and vapor from the flash chamber. There are 26 bubble trays in the upper part of this column, some of which are inspected through 16-in. manhole plates and some through 8-in. handhole plates. The top temperature of the column is controlled by liquid reflux taken from the pressure-distillate accumulator drum by an 8-in. by 6-in. by 10-in. duplex steam-driven pump, and delivered to the column above the top plate at a ratio of 3.25:1. The vapor outlet temperature is thus maintained at approximately 394 deg. fahr., producing a raw pressure distillate having an end point of approximately 394 deg. fahr. when condensed.

The pressure-distillate vapors are cooled by passing them through the crude-to-vapor heat exchanger, and then through 25 2½-in. parallel condensing coils, each section containing 356 sq. ft. of cooling surface. Condensed vapors are maintained at a temperature sufficiently high to prevent more than a small part of the highly-volatile fractions being condensed at this point.

Vapors from the pressure-distillate receiving drum are passed through a recovery system, and utilized for adjusting the vapor-pressure of the finished gasoline, which varies seasonably. The liquified pressure distillate is pumped directly from the receiver drum to the plant stabilizer, where excess butanes are removed.

Before the unit was rebuilt, an average of 1650 bbl. per day of 30-gravity crude was processed, which yielded 63.5 percent gasoline having an octane value of 68.5 at 10-lb. vapor-pressure. There was 29 percent residuum produced, having a gravity of 8 deg. A.P.I. and a furol viscosity of 300 at 122 deg. fahr. Gas and loss averaged 7.5 percent.

Under the present arrangement, i.e., two furnaces cracking and full flashing, the amount of 30-gravity crude charged to the unit averages 3200 bbl. per day. The pressure-distillate production is 60.63 percent, but its octane value is 72.6. A distillate cut having a gravity of 38/40 constitutes 5.12 percent of the product. The residuum produced at present averages 26.71 percent and is of 7.6 deg. A.P.I. gravity, and has a furol viscosity of 250 at 122 deg. fahrenheit. Gas and loss totals 6.54 percent.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Bleaching Clay

Part 7

The adsorption process in the contact method

By RAFAEL FUSSTEIG

FORMERLY oils were decolorized by the percolation process only, the oil being allowed to seep through a bed of coarse Fuller's earth. Later, the use of fine bleaching clays, the so-called contact process, was adopted because agitation of the oil with a fine-grained adsorbent resulted in more efficient utilization of the adsorption surface, that is, of the microscopic channels. Treatment of petroleum products by the contact process has numerous variations. Bleaching clay can be added to the oil in the still, and the oil distilled. This method is old but is said to be efficient and to reduce the consumption of bleaching clay; however, the addition of the clay in the still has obvious disadvantages. The high temperature of distillation destroys the microscopic structure of the bleaching clay, and the long period of contact between the clay and the oil causes polymerization, which impairs the quality of the oil. The oil seems to be completely decolorized, but after a time begins to darken because of polymerization induced by the catalytic action of some unknown higher unsaturated hydrocarbons on the other hydrocarbons.

Another common contact-treating practice is the addition of the adsorbent material to the oil, followed by agitation and then filtration of the oil through the adsorbent, thus combining the principles of contact and percolation. Of course, the temperature and the duration of contact are important. The temperature varies over a rather wide range, and must be determined experimentally for each oil and bleaching clay. This determination is necessary in order to avoid excessive temperature, which would cause the oil to decompose, or the bleaching clay to lose its adsorptive power as a result of the destruction of the microscopic structure. On the other hand, use of too low a temperature decreases the adsorptive power of the bleaching clay. This phenomenon can be explained by the fact that, when the temperature is too low not all the air is expelled from the microscopic channels. The temperature at which the microscopic channels contain no air is regarded as the best for the adsorption of oils. It is between 250 deg. fahr. and 350 deg. fahr. for most paraffin-base lubricating oils, but may be as high as 600 deg. fahrenheit. Of course, the less efficient clays generally must be used at lower temperatures than the better bleaching clays. The time of contact is variable and also depends upon the sort of oil and upon the sort of clay. If the oil contains large amounts of unsaturated hydrocarbons, a long period of contact causes the formation of certain compounds, colorless and soluble in oil, that are able to combine with even the saturated hydrocarbons; furthermore, the less efficient clays usually require longer contact time; therefore, the time of contact must be determined experimentally for each bleaching clay, for each oil, and for each type of agitation.

Light petroleum products, such as kerosene and straight-run gasoline, can be brought into contact with bleaching clay either after settling and withdrawing the main portion of the acid sludge subsequent to acid-treating, or while all the acid sludge produced by the acid treatment is present in the distillates, the sludge being adsorbed and completely removed from the oil by the clay. In the treatment of heavy petroleum products, such as lubricating oils and paraffin waxes, an acid treatment usually is applied before the clay treatment, the sludge from the acid treatment being withdrawn before the oil, still in the acid state, is mixed with the adsorbent material. Acid and clay can be added to some oils simultaneously, or the clay and acid mixed first and then applied to a raw or neutral oil. These two methods are less satisfactory than the preliminary addition of acid, because some unknown hydrocarbons are produced during the common contact of clay and acid, causing deterioration of the refined oil after it has stood a short time. It is thus seen that the best method for the decolorization of oils is by acid treatment, neutralization, and clay treatment.

The clay can be applied in one or in several batches or continuously. In treating light oils with small quantities of clay, the clay is always applied in one batch. The presence of a small quantity of acid with the clay is necessary for developing decolorizing action, and when a large volume of clay is used in treating, a part of the acid can be left in the oil or a small amount of fresh acid added before the clay is introduced. In treating some oils the acid is neutralized with caustic soda solution, as much of the water and its dissolved constituents as possible withdrawn, and the slightly alkaline oil then mixed with the adsorbent. When the oil is heated most of the water is evaporated. The concentrated alkali completely neutralizes the weak organic acids. This reaction causes the formation of soaps, which are removed by the adsorbent material. In other words, this reaction is necessary if the oil contains weak organic acids. The adsorbent material does not remove all these organic acids from the oil, and lubricating oils are not satisfactory unless freed of the organic acids. Proper neutralization requires an exact amount of alkali of known concentration. An excess of strong alkali lowers the adsorptive power of the adsorbent, as well as the rate of filtration because of the formation of certain salts that inhibit contact between the adsorbent material and the oil. The inside layer of the microscopic channels reacts with the strong alkali, forming compounds that fill the microscopic channels. As the microscopic channels are constricted as a result of this reaction, the adsorptive power decreases, and when the microscopic channels are filled completely with the above-mentioned compounds, the adsorptive power of the clay disappears. In general, a neutral or slightly acidic condition of the lubricating oil, and nearly complete freedom from organic acids or soaps, give best results in the contact clay treatment. Sometimes the adsorption of impurities from oils is increased by adding a fine-grained lime to the oil. This compound neutralizes acid in the oil and increases the tendency of the impurities to be adsorbed. Appar-

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ently the lime particles themselves become surrounded by a film of the undesirable hydrocarbons.

Certain clays used for treating heavy petroleum products are thoroughly moistened or made into a mud by adding water before they are applied to the oil. The additional water produces steam, which aids agitation, and the layer of steam above the surface of the oil prevents oxidation of the oil by air. Mechanical agitation or, when aging heavy petroleum products, agitation with superheated steam is preferable to agitation with air, as the latter causes excessive evaporation of light oils and consequently greater fire hazard. In addition, the air causes a darkening of light and heavy oils. Because of the beneficial effect of water in contact clay, refiners often find it economical when using clay activated with acid to employ the wet clay or pulp from the activation process, without first drying it. A very interesting combination of bentonite activation and use in the wet state in the contact treatment of heavy oils, is employed in Russia[1]. (Fig. 1.)

The raw bentonite passes to the vessel (1), then to the Raymond impact pulverizer (2), which is equipped with ventilators to sort the fine-grained material and direct it to the separator (3). From here the bentonite falls into the agitator (4), where the leaching process takes place. In this agitator water and concentrated sulphuric acid are added in the following proportion: with each 100 kg. of bentonite are mixed 100 kg. of water and 20 kg. of concentrated sulphuric acid. Direct steam enters at the top of the agitator (4) at a temperature of 210 deg. fahr., thoroughly mixing the clay, water, and sulphuric acid. The leaching process lasts eight or ten hours, during which time all soluble compounds are leached from the interior of the microscopic channels. When the leaching process is completed, the mixture is directed to vessels (5) and (6), through which water flows countercurrently. This operation, requiring two to three hours, is continued until the wash water contains less than 0.2 percent acid. The water then is settled and withdrawn, and the pulp is directed to vessels (7), (8), and (9), where the water is settled further. The operation is regarded as completed when the pulp contains 25 percent bleaching clay and 75 percent water. This pulp is then directed to vessel (10), from which it is pumped to the contact agitators (11) and (12). In these agitators the adsorption process takes place. Of course, the very heavy oils must be diluted with naphtha in order that all oil particles may be brought in contact with particles of bleaching clay. After the bleaching process is completed, the mixture passes to the evaporators (13) and (14). Here the bleaching clay is blown with air. In the evaporators the separation of water vapors, SO_2, and uncondensed hydrocarbons occurs, and these substances are condensed in the condenser (15). The mixture of oil and clay passes to the tubestill (16), where the mixture is heated to 475 deg. fahr. and allowed to enter the cooler (17). After the mixture is cooled it is directed to the filter press (18), where the oil and clay are separated.

The amount of clay required for treating heavy oils varies from 2.5 to 25 percent of the weight of the stock. The amount of clay required for the decolorization of light oils is very small and depends upon the quantity of unsaturated hydrocarbons in the oil. Light petroleum products such as gasoline, gas oil, and spindle oil are usually subjected to the contact process after acid treatment; however, there are two schools of thought. One group treats the light product with acid, then washes it with water and neutralizes it with caustic soda solution prior to the clay treatment; the other group treats light products simultaneously with acid and clay, the clay, which is basic, neutralizing any excess acid in the product. Certain other refiners acid-treat the oil, wash it with water, neutralize it with caustic soda solution and run the product to storage, allowing it to stand for a few days, after which it is given a clay treatment.

It can not be stated which of these processes is the best, because contact processes are still in the development stage, and there is room for much research and investigation. In treating some particular oils the fine clay must be used on the neutralized oil, but more often than not it will be found that if the oil is properly acid-treated the clay can be applied directly to the sour oil and a finished product of improved quality will result.

Too often, if the clay is to be mixed directly with the sour oil, the acid treatment used is the same as would be used if the oil were to be neutralized with soda. This is a mistake. It will be found that if the clay is added to the sour oil, less acid is required to produce results comparable to those obtained by soda neutralization, at least insofar as color is concerned. To effect the greatest economy it is necessary that there be a balance between acid-treatment and clay-treatment. In this way it is possible to reduce the amount of acid used and also the acid-treating loss.

When clay is added to a neutralized oil, it generally will be found necessary to increase the amount compared with what would be used for sour oil. In planning the contact process the regular cut-and-try method must be employed, experimenting with small acid-treats. Care should be taken that the oil is as free from sludge as possible, although excessive sludge is not so undesirable in oil intended for contact-treatment as it is in oil that is to be neutralized with soda. With naphthene- or asphalt-base oils it is possible to use much more water for water wash settling than would be desirable were the oil to be neutralized with soda. It may even be advisable to add several percent of water to the sour oil and agitate it thoroughly before the clay is applied. If the oil carries black,

(Continued on Page 74)

[1]Trudi Mas Lianoi Komisji, Moskwa, 1933, Karsky, page 111.

Fig. 1

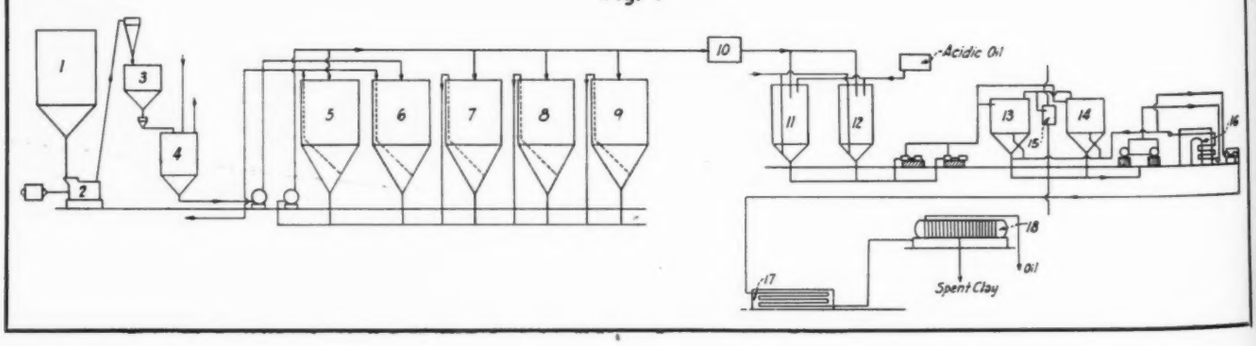

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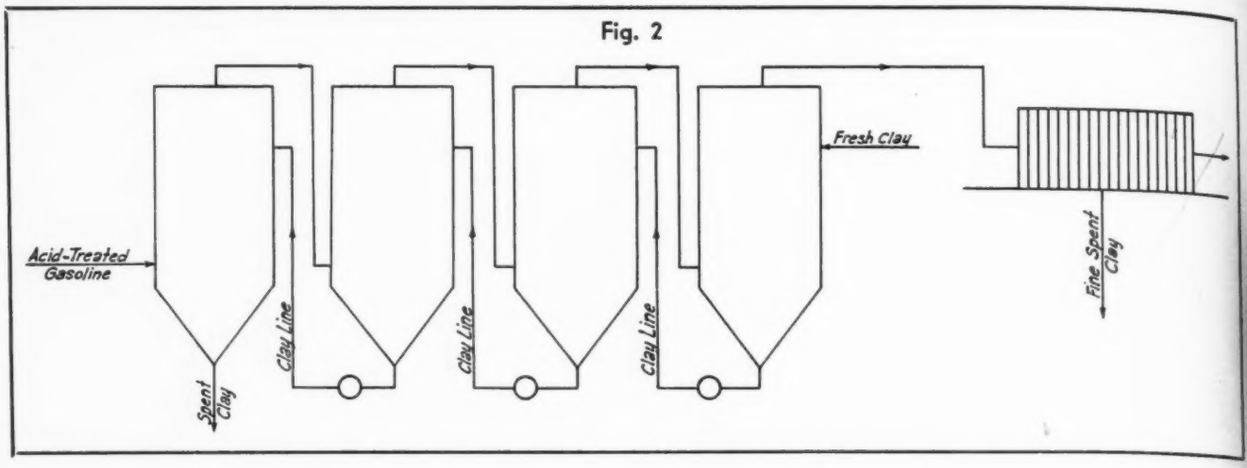
Fig. 2



(Continued from Page 72)

resin-like particles in suspension it will pay to add more water. This seems to bring down the sludge as a coke mixed with the clay but not clogging its pores.

The oil to be treated may also be preheated in tubestills. It is possible, but hardly practicable, to mix the oil and clay before heating and to digest the mixture under a reflux condenser. Frequently, a similar procedure is employed in Germany, where the bleaching clay "Tonsil" is used in the form of a pulp. The acidic oil is mixed with clay in an Erfurt's emulgator by means of compressed air. The emulsion is passed to special vertical furnaces, in which it is heated to the proper temperature, which should be below the cracking temperature. From the furnace this emulsion passes to the evaporator, in which the water is eliminated. The mixture of oil and bleaching clay remains in the top of the evaporator and is mixed by means of steam. From the top of the evaporator the mixture passes to the cooler, where it is cooled to the proper temperature. After this mixture is cooled it is pumped to a special cell filter, in which the oil is separated from the clay.

For mixing the clay most refiners use mechanical mixers. The mechanical mixers can be used only when the product is a very thin liquid, such as gasoline, kerosene, or spindle oil. Viscous oils must be diluted with naphtha before they can be agitated by a mechanical mixer. After the gasoline and clay are mixed some refiners pump the mixture through a vertical tank, maintaining the velocity of the stream at such a rate that the particles of clay are held in suspension. This procedure seems to give maximum contact of the clay and gasoline. From the mixer the gasoline passes to the filter, in which the particles of clay are removed. Instead of using a mixer, some refiners use a system of tanks and introduce the clay countercurrently to the gasoline stream. (Fig. 2).

This method of applying the clay gives good results, but the equipment occupies considerable space. The tanks should be of a size to permit the settling of most of the clay. The stream of gasoline that comes from the last tank must be filtered to remove the last traces of clay.

Paraffin-base oils should always contain some water. If water is used after washing out the sulphuric acid it should be sparingly and never should an oil of this kind be wet when the clay is applied. This is particularly true of residual oils and cylinder stocks. When a sour oil is to be neutralized with soda it should be air-blown before the soda is added, but if the oil is to be contact-treated, it should not be air-blown. Any acid gases that would be blown out by the air will pass off when heated and the excess acidity seems to improve the action of the clay.

As mentioned, the clay can be applied in one batch or in several. It has been established by the writer's investigations that if two batches are used the adsorption surface of the second batch is not completely exhausted. Therefore, it should be economical to use such half-spent clay as the first batch in subsequent contact treating.

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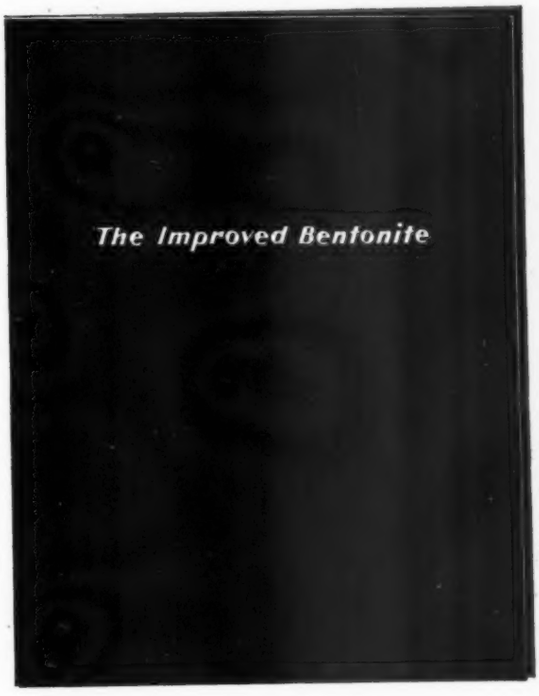

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By DAVE HARRELL
Corrosion Engineer, Houston Pipe Line Company

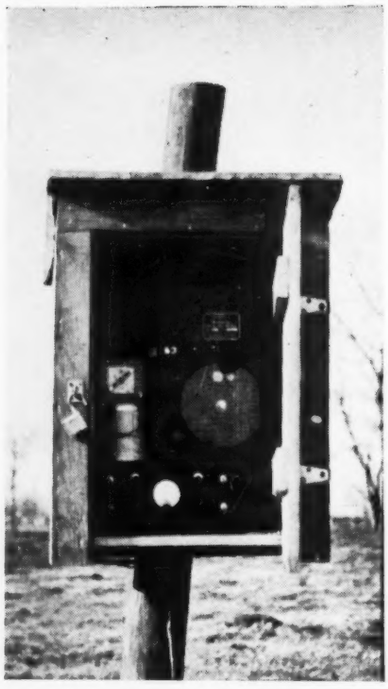

Fig. 1. Recording vacuum-tube voltmeter

BEFORE the development of the recording vacuum-tube voltmeter, measurement of results obtained by use of windchargers on pipe lines was largely guesswork. This type of wind-driven unit is in widespread use and it is very gratifying to find that most of the things we thought were true concerning its operation are actual facts. The things we suspected concerning the disadvantages of this type of unit also have been revealed and we believe we have the remedy for the most serious objection thus far discovered.

Fig. 1 shows this recording vacuum-tube voltmeter, by means of which it is possible to record pipe-line earth potentials over periods of days and weeks without any of the errors formerly involved vitiating the results. Time and space will not permit a description of this device, but examination of the curves presented with this article provides ample proof that the voltmeter not only supplies the information we have been seeking, but opens many new avenues of attack on the problem of prevention of corrosion.

The writer examined his list of windcharger installations on the lines of the Houston Pipe Line Company and selected one at which to install this vacuum-tube instrument. At the location selected there is little or no coating on the line and the wind-driven generator is being used to protect approximately 1000 ft. of 18-in. high-pressure gas line including the crossing under a small lake where the pipe replacement cost would be high.

The vacuum-tube voltmeter was installed at a point about 600 ft. from the windcharger and on the opposite side of the lake. Fig. 2 shows the single windcharger as it was before we began devising means of improving its performance. The windcharger is mounted on a 40-ft. telephone pole and is the 32-volt type as the earth resistance is as high as one ohm in this vicinity. The windcharger is capable of charging 25 amperes maximum and five amperes minimum, which latter charge is obtainable in a three-mile wind because of the gearing up of the generator. The feeder system is the usual type and consists of several joints of junk 4-in. pipe driven into the bed of the lake and connected to the unit by a 00 copper wire that once saw service as a street car trolley cable. The line walker's crossing bridge can be seen in the center of the picture. (Fig. 2.)

Fig. 2. Single wind-driven generator and positive feeder system

During the month of November, 1937, this windcharger protected the pipe line 46.38 percent of the time; the rest of the time the velocity of the wind was too low for it to operate. We knew there was some time interval

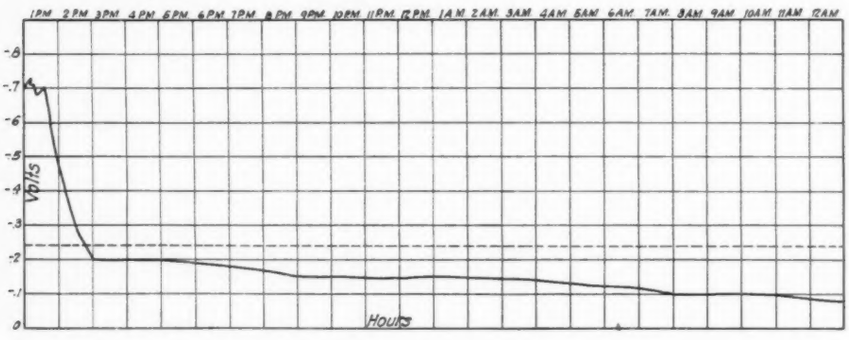

Fig. 3. Potential decline curve

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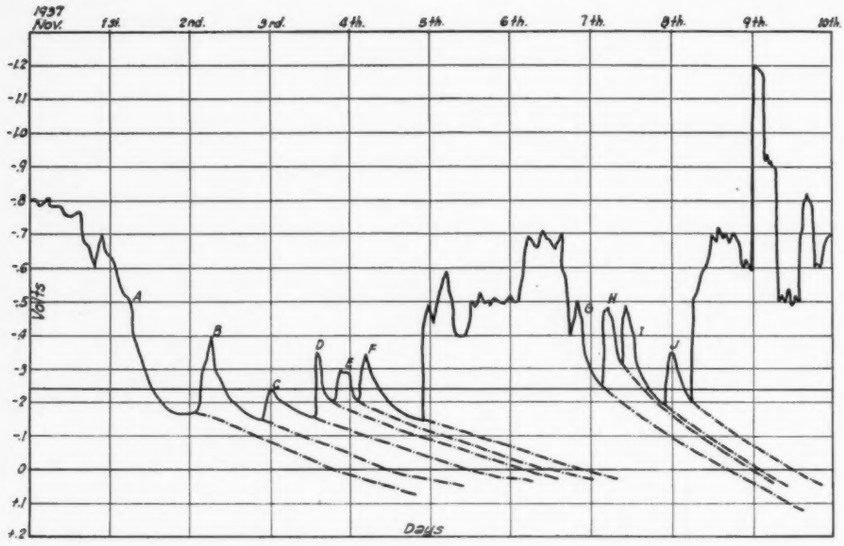

Fig. 4. Charge on pipe line by windcharger first ten days of November, 1937

that the slope of the curves from points A, B, C, D, E, and F is identical with the one plotted on Fig. 3. They have been extended as dotted lines to show how the negative potential would have fallen had not the windcharger again tripped the relay and recharged the line. We find, however, that the slope of curves G, H, I, and J is much steeper than that of A, B, C, D, E, and F, and this tells us that the negative decline curve depends not only on the length of time during which no charge is placed on the pipe, but also on the length of time that the line is charged in successive intervals. The heavy line was drawn at protective potential, which again was chosen at minus .24 volt. It will be seen that the charge on the pipe was actually below protective level for a period of 62 hours during this first ten-day period, which is entirely too long to assume that we are getting anywhere near perfect cathodic protection from this type of installation. It was also noted from this same curve, Fig. 4, that the line was overcharged more than it was undercharged and it was reasoned that this overcharge was just so much wasted power.

At first an attempt was made to cause the windcharger to charge a storage battery that discharged continuously into the feeder system. This was successful in that it took the big humps out of the curve, but the wind-

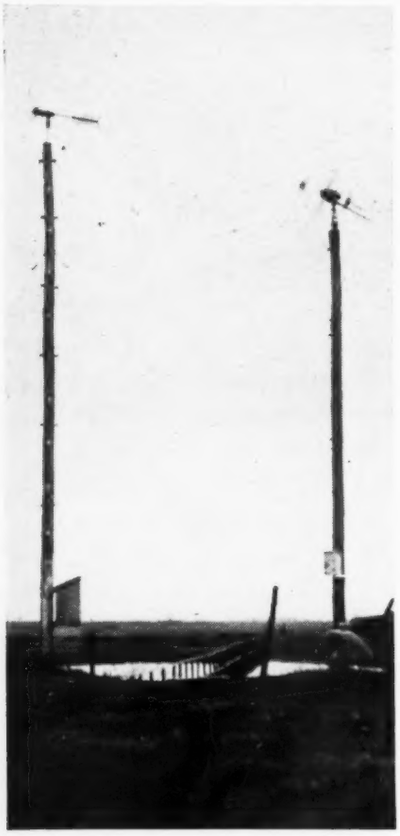

Fig. 5. Dual windcharger installation

the rate of leakage was rapid during the first hour and 20 minutes after the mill stopped, after which period it declined slowly as indicated and the line would have returned to its original positive condition in a period of about 18½ hours. The windmill was deliberately stopped in order to allow the recording instrument to draw this curve and when there was no further doubt concerning the trend the mill was started again, as we did not want to lose even the small protection that the unit was providing. The dotted line on Fig. 3. is drawn at minus .24 volt, which is the potential at which we have found cathodic protection begins.

The next step was to plot our recording curve over a period of a month. This made a long, irregular curve. Fig. 4 shows the first ten days of this curve. It will be noted after the windcharger stopped in which the charge remained on the line, but it was not until we installed the vacuum-tube voltmeter that we were able to plot the curve indicated as Fig. 3. This curve revealed that

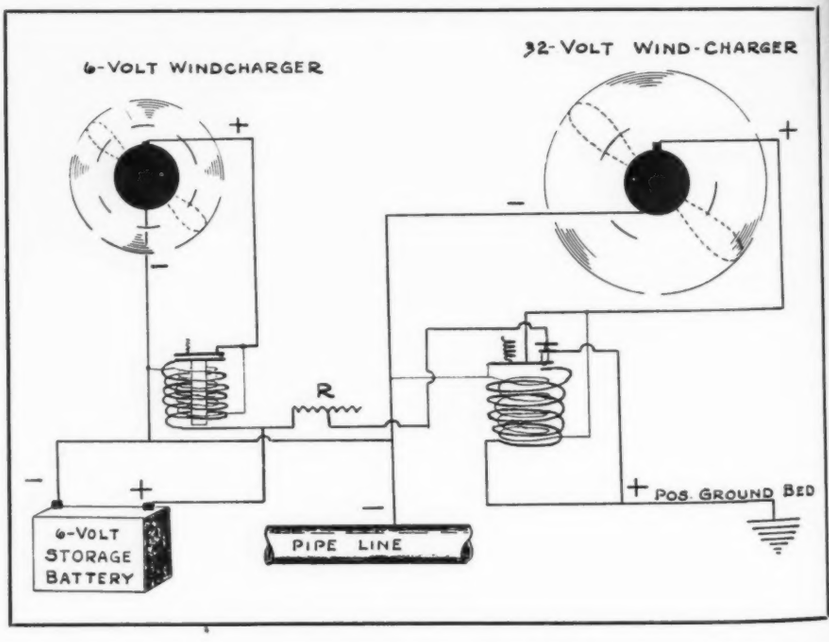

Fig. 6. Diagram of connections, two windchargers and a storage battery

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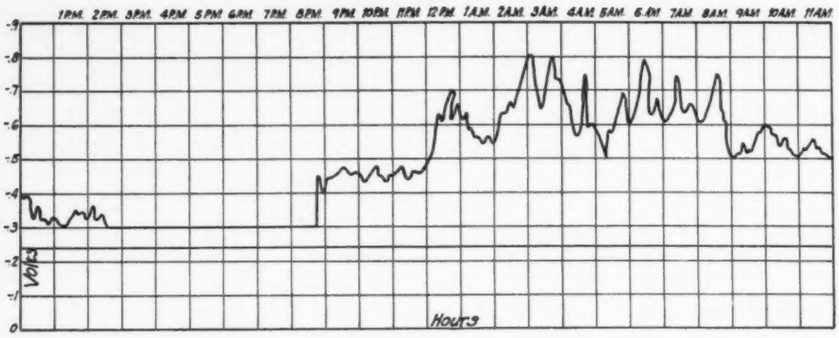


Fig. 7. Potential curve for two windmills and a storage battery

charger could not supply enough current to charge both the pipe and the battery, so it was decided to use two windchargers and one battery. It was found that less current was required to maintain the pipe at an even charge of, say, minus .3 volt if applied after the windcharger had been running for a long period than was needed when the windcharger had been stopped and the charge on the line had fallen to a point on the lower part of the negative decline curve. From this information it was thought that a second windcharger, whose only function was to charge the battery while the first one was supplying current to the pipe line, would be satisfactory. It has been placed in operation and has been giving excellent results for the last month and a half with no signs of the battery weakening.

Fig. 5 shows the installation of the two windchargers. The second one installed is only a 6-volt charger as it was found that a 6-volt battery would discharge six amperes against a resistance of one ohm, which is the resistance of the variable resistor grid shown in the diagram of connections as "R" (Fig. 6). This current was ample to maintain the negative potential at minus .3 volt on the extreme limit of expected protection, which was in the area where the vacuum-tube voltmeter was installed.

Fig. 7 shows what happens when the large windcharger does not charge the line during a period of six hours and 20 minutes in one day. It will be seen that all the readings on this curve are above the danger point, which is minus .24 volt.

The operation of this unit is now fully automatic in that when the wind blows, the relays on both the 32-volt and 6-volt chargers are drawn down, thus causing the 6-volt machine to charge the battery and the 32-volt one to charge the pipe line. When the wind stops, relay No. 1 on the large machine opens, thereby closing the battery circuit immediately. If the wind were still strong enough to run the small windmill it would charge the battery while the battery was discharging to the line; however, both mills quit charging when the wind velocity drops below two miles an hour. Two large storage batteries were obtained that had a capacity of 120 amp-hr. each. These were connected in parallel to give a total of 240 amp-hr. capacity on a fully-charged battery. This means that at a five-ampere drain these batteries should carry the load for a period of 48 hours without further charging. Assuming that the batteries are 80 percent efficient, the maximum average charging rate must exceed the average discharge rate by 120 percent. Thus far the danger from overcharge has been so great that we will soon install voltage regulators on this and all similar installations to prevent the small windcharger from overcharging the batteries during long periods of high wind velocity. Fig. 8 shows the pole box for the large windmill. This contains the relay and the extra set of contact points. This relay was made from a standard automobile relay cut-out. The heavy winding was wound with No. 8 enameled wire so that the heavy load would not cause overheating on 25 amperes, which is sometimes charged by the large windcharger. The separate contact points are attached to a hard rubber mounting on the side of the relay and above the movable arm. There is no electrical connection between the battery circuit and any part of the relay.

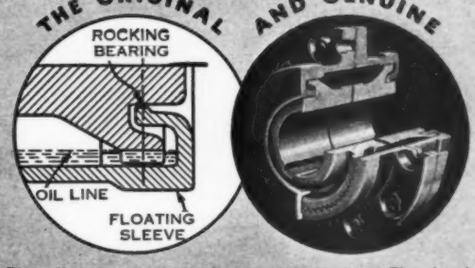
Fig. 9 shows the pole box for the small windcharger. It houses the batteries, relay, and ammeter. The position of the boxes on the poles may be seen in Fig. 5.

There have been times when we have not had any wind in this locality for a period of two days, but these are very rare occasions and we do not believe it will be necessary to increase the size of the batteries in order to carry the load for that length of time.

Fig. 8. Pole box used with large windcharger

Fig. 9. Pole box and battery used with small windcharger

THE SUPERIORITY SHOWS UP IN PERFORMANCE



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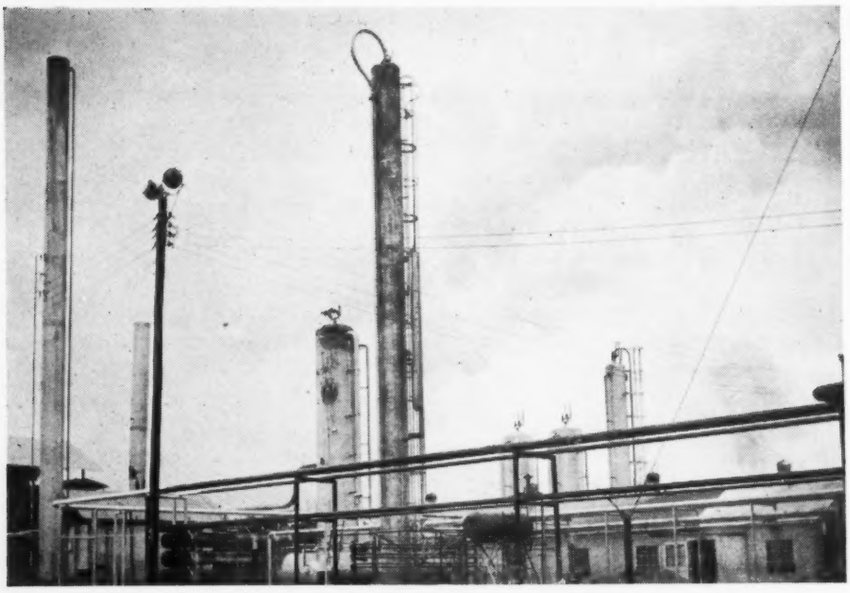


Distillation equipment

Use of tubestill heater instead of a refired reboiler, burial of gasoline storage to reduce vapor loss, and loading of gasoline under pressure among features of Miller County, Arkansas, plant

New Gasoline Plant Operates on High- and Low-Pressure Gas at Well Pressure

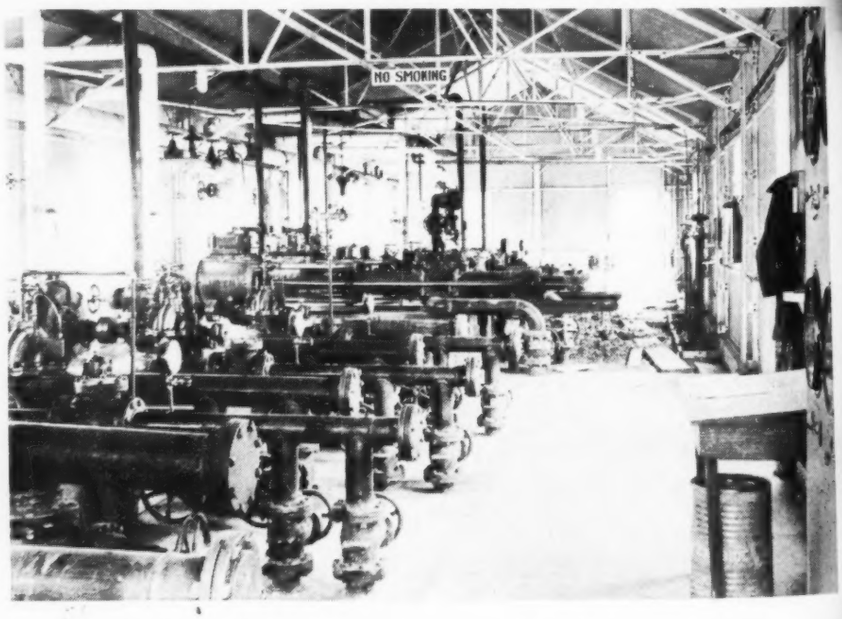
By FRANK H. LOVE

F. W. BURFORD recently completed and put in operation an absorption-type gasoline plant in Miller County, the Arkansas end of the tri-state Rodessa field. Known as the Capps Gasoline Plant, it has a capacity of 100,000,000 cu. ft. of gas per day and is operated at well pressure. Gas produced with oil is handled by the low-pressure side of the plant and that from gas-distillate wells by the high-pressure side. A number of interesting features have been incorporated in the design of the plant.

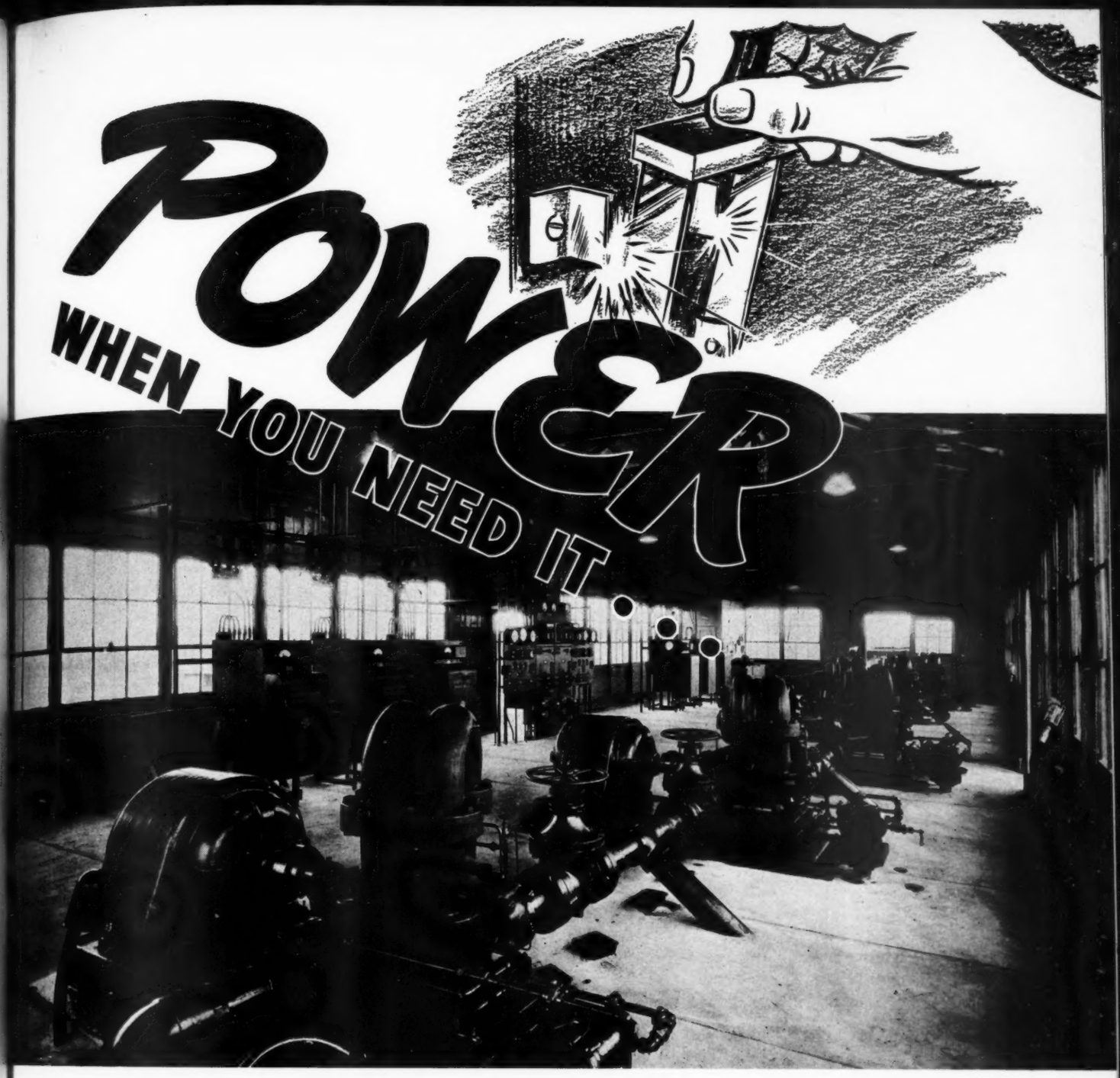
Upon being received at the plant the gas is cleaned by two 84-in. low-pressure and one 48-in. high-pressure scrubbers, passing then into the absorbers, these being of the same number and size as the scrubbers. The low-pressure absorbers are operated at a pressure of 30 pounds. The stripped gas is given a second cleaning by two 60-in. low-pressure and one 42-in. high-pressure outlet scrubbers. The bulk of the gas is returned to the producing sand and is utilized in flowing wells on the leases that supply the plant with gas.

Fat oil from the two low-pressure absorbers is discharged to two parallel banks of three heat exchangers in series, having a total surface of approximately 12,000 sq. feet. For handling this fat oil two centrifugal pumps are available, one serving as a standby.

Fat oil from the high-pressure absorbers is discharged into a 42-in. flash tank where it is reduced to a pressure of 150 pounds. Vapors venting off this tank are returned to the low-pressure absorbers. The two streams of fat oils combine just prior to their entrance into the heat exchangers, where they are heated to a temperature of approximately 300 deg. fahrenheit. The oil then passes to a tubestill heater and its temperature increased to approximately 360 deg. fahrenheit. Use of this tubestill heater is a departure from customary practice. It is employed in this instance instead of a refired reboiler, effecting a reduction in first cost, according to officials of the plant. The tubestill heater is constructed with suspended walls and arches and is similar to the heaters used in refinery service.



Interior of pump room



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The fat oil is next admitted to a 72-in. diameter by 45-ft. high fractionating still, operated at a pressure of 40 lb., where it is steam-distilled. The temperature maintained at the top of the unit is 214 deg. fahrenheit. Vapors from the top of the still pass into and through five primary condensers, thence into a 36-in. by 6-ft. water separator where the steam is condensed and removed.

The gasoline is taken to two final coolers, thence to a 60-in. by 20-ft. gasoline accumulator tank. The reflux pump to the still takes suction from this tank and returns gasoline to the top of the still to control top temperature.

Stripped lean oil passes through the shell of the heat exchangers, being cooled to a temperature of approximately 140 deg. fahr., thence to 12 atmospheric coolers having approximately 6000 sq. ft. of surface, and to a 60-in. by 20-ft. lean oil surge tank. The centrifugal pumps handling low-pressure lean oil and the plunger pumps handling the high-pressure lean oil all take suction from this surge tank and discharge into the low-pressure and high-pressure absorbers.

The stabilizer-charging pump takes suction from the gasoline accumulator tank and discharges through a bank of heat exchangers and a preheater into a 42-in. by 70-ft. stabilizing column, the pressure upon which is maintained at 190 lb. gauge. The bottom temperature is maintained at 260 deg. fahr., and the top of the tower operates at a temperature of approximately 100 deg. fahrenheit.

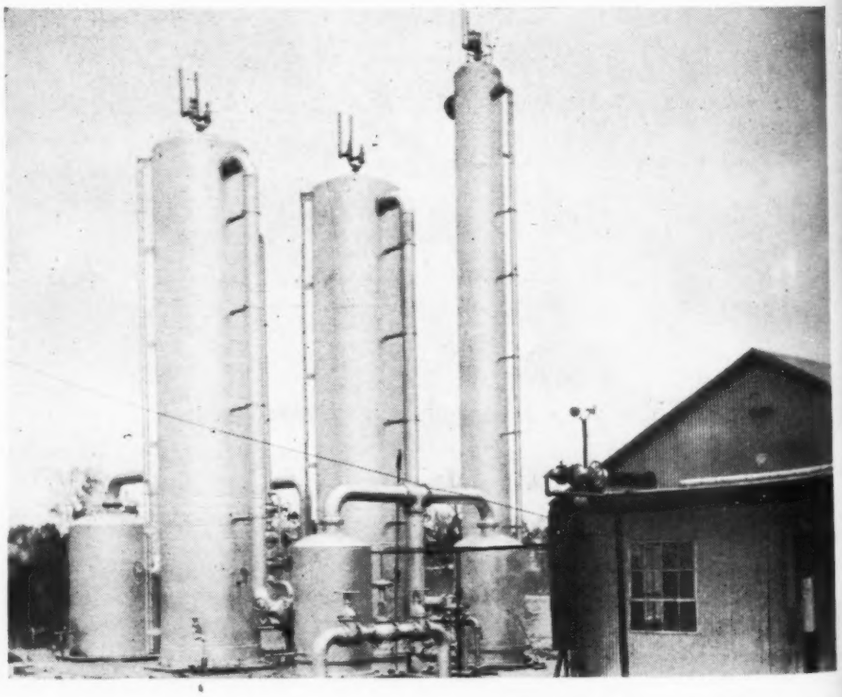
Vapors leaving the top of the stabilizing column go to two atmospheric condensers, thence to a 42-in. by 8-ft. reflux accumulator at a temperature of approximately 75 deg. fahrenheit. The reflux pump takes suction from the accumulator and discharges the gasoline to the top plate of the stabilizing column. The finished product in the reboiler passes from this equipment through heat exchangers and to four final atmospheric coolers, thence to storage. Storage consists of ten 10-ft. by 40-ft. horizontal tanks having a total capacity of 250,000 gallons. The tanks are buried in the manner shown in an accompanying illustration for the purpose of reducing loss from evaporation.

Steam used in the operation of the plant is provided by two 400-hp. watertube boilers having air-cooled walls. The boilers are operated at a pressure of 150 pounds. The required electrical power is generated by two standard generators driven by 30-hp. internal combustion engines using gas as fuel. The cooling tower is 130 ft. long by 20 ft. wide and 50 ft. high, having a capacity of 3000 gal. per minute. All water used in the plant is obtained from two deep wells, flowed by gas-lift.

To load the finished gasoline into tank cars gas pressure of 30 lb. is applied to the storage tanks. As the loading rack is 65 ft. lower than the tanks a pressure of 30 lb. is ample to boost the gasoline the two and one-half miles for loading.

Every effort has been made to avoid the loss of vapors, and those coming off the gasoline accumulator and storage tanks are returned to the low-pressure absorbers by maintaining a pressure on these tanks in excess of the 30-lb. gauge operating pressure of the absorbers.

At present a 26-lb. vapor-pressure gasoline is being produced.



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The photograph shows a Jones-Shelburne rig on a Ward Oil Company lease near Kilgore, Texas. Left to right, the men are: Chas. Hatfield, helper; John Ruff, Jarecki Division Manager; Carl Holland, truck driver; Ivy Cody, driller; Bob McChesney, Supt., Ward Oil Co.; Dick Schmitz, helper; Tommy Bond, helper; Roy Guffey, Supt., Jones & Shelburne, Inc.; Paul Stiles, Union Wire Rope Corporation.

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Running Tour
WITH MEN IN THE INDUSTRY

R. BENARDEAU has resigned his position as mechanical engineer with Stanolind Oil and Gas Company in Tulsa and is now manager of the Franco Dominion Development Corporation, a French corporation having producing properties in the Oklahoma City field.

BUSTER BAEBEL, formerly production foreman for the Gulf Oil Corporation at Rosenberg, Texas, has been transferred to England.

DR. W. L. LINTON, formerly in charge of the Technical Service Division of General Laboratories of Socony-Vacuum Oil Company, has been appointed superintendent of Sone & Fleming Works. **P. V. KEYSER, JR.,** who has been assistant supervisor, succeeds him. **A. E. ESSER,** formerly superintendent of Sone & Fleming Works, has been appointed chief engineer of the Eastern Marketing Division of the Socony-Vacuum Oil Company.

JOHN W. NEWTON has been appointed to the position of manager of refineries of the Magnolia Petroleum Company. He was formerly assistant manager of refineries for the company.

C. B. McCLINTOCK, geologist and consulting petroleum engineer of Oil City, Pennsylvania, has been engaged by the University of Pittsburgh to deliver one lecture a week to the senior class in petroleum engineering for the second term of the current school year.

NICOLAS THEODORESCO has been elected president of Creditul Minier S. A. Roumaine, and **MICHEL CONSTANTINESCO,** formerly general manager and a member of the board, has been elected to succeed him as vice-president.

A. M. CROWELL has resigned his position as gas engineer for the Texas Railroad Commission, effective April 1, in order to become chief conservation agent for the state of Arkansas. He was serving as supervisor of field engineering and research for the Texas agency.

ROBERT L. HAGUE, general manager of the Marine department and directly associated with the Standard Oil Company for the last 29 years, has been elected a vice-president and director of Standard Oil Company of New Jersey.

CARL L. MAYER has resigned his position as president of the Red Bank Oil Company, Houston, Texas, effective April 1. He will continue to be active in the oil business.

LLOYD I. YEAGER, Texas district geologist for the Cities Service Oil Company, has resigned and will return to his former territory to engage in consulting work at Wichita, Kansas.

C. L. RAWE, engineer for the American Liberty Oil Company at Bivins, has been transferred to Seagraves, Texas, and has been promoted to district superintendent.

R. V. CHAPMAN, production foreman for the Ohio Oil Company, has been transferred from Sallyards to Reece, Kansas.

G. T. RHODEN, formerly superintendent in the Cleveland and Segno fields, Texas, has been transferred by the Gulf Oil Corporation to Lake Charles, Louisiana.

ANGUS McLEOD has resigned his position as chief geologist for Shell Oil Company, Los Angeles, California, and will engage in consulting work.

R. H. ALEXANDER has been transferred from Kermit, Texas, to Lovington, New Mexico, by the Magnolia Petroleum Company, and has been promoted from production foreman to superintendent of the new Lea district.

O. B. MULLINS resigned March 1 as general manager of production for Derby Oil Company at Wichita, Kansas, and is now supervisor of field operations for Tom C. Johnson. **CLIFF MERCER,** formerly district supervisor for Derby at McPherson, succeeds him as general production superintendent.

H. F. FORTINBERRY, production superintendent for the Gulf Oil Corporation, has been transferred from Breckenridge to Odessa, Texas. **H. D. BELL** has been transferred from Electra to fill his place, and **WILLIAM NEEDHAM** has gone from Nocona to Electra.

LEO R. FORTIER has been transferred from the district managership of the exploration department of the Shell Petroleum Corporation at Wichita, Kansas, to the Shell Oil Company at Los Angeles, California.

WALTER HELMS, Texarkana, has been appointed to the Arkansas Board of Conservation by Governor Bailey. He will fill a vacancy resulting from a recent resignation.

RALPH B. ROARK, vice-president of the Shell Petroleum Corporation, Tulsa, Oklahoma, will hereafter preside over a larger district, as the North Texas area has been added to his territory.

A. C. GALBRAITH was recently elected a vice-president of Union Oil Company of California. During the last few years he has been in charge of industrial relations and personnel, and in his new position will continue to direct this work.

STUART A. GIRAUD, general manager of the refining department and manager of sales for the Humble Oil and Refining Company, has been elected to the board of directors. **L. T. BARROW,** head of the geological department and a director, has been elected a vice-president.

MARVIN LEE has resigned as technical advisor to the State Corporation Commission of Kansas to resume his consulting work in geology and production at Wichita, Kansas.

R. B. HIGH, manager of the manufacturing department for the Shell Petroleum Corporation, has been made manager of the Shell Pipe Line Corporation. He succeeds R. F. Smith, resigned.

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LAUGH WITH BARNEY

Edited by BARNEY HORRIGAN

"Little boy, why aren't you in school?"

"Hell, lady, I ain't but three years old!"

* * *

Making 100%

A medical student who had been out on a big party until about 5:00 A. M., sat in a class room trying to pass an exam. His head was fairly buzzing with the hang-over from the party, and he could just about see the paper. The first question was:

Name five reasons why mother's milk is better for babies than cow's milk.

The student scratched his head and put down:

1. It's fresher.
2. It's cleaner.

Then he thought awhile and wrote:

3. The cats can't get at it.
4. It's easier to take to a picnic.

Well pleased with the results he had so far achieved, he studied long on the last reason. He thought and thought, but could not remember what the last reason was. Finally he had an inspiration. And the next day the professor read as the fifth reason:

5. It comes in such cute containers.

* * *

Mrs. Simpkins: Listen to me. I'm sick and tired of hearing you talk about 'my car' and 'my furniture' and 'my son.' It's getting on my nerve and you're going to learn to say 'our.' What are you looking for now in that closet?

Mr. Simpkins: Our pants.

* * *

"No, you can't take my daughter riding."

"Why not?"

"I don't allow college boys to go out with my daughter."

"But I ain't a college boy. I work over in Kelly's pool hall."

"I beg your pardon, sir. My daughter will be ready in a moment."

* * *

A few years ago the Chattanooga *Times* management decided that there had been too great use of nicknames in the paper and laid down a rule that copy desk and proof desk should be vigilant to eliminate this practice, particularly in society copy. The desks were told to make it Joseph instead of Joe, Thomas instead of Tom, etc.

The backfire came when a proof-reader, poring over a story of a football injury, changed a line to make it read: "The stellar U. C. fullback was found to have sustained a severe Charles Horse."

* * *

Pat determined to pass his favorite tavern on his way home. As he approached it he became somewhat shaky, but after plucking up courage, he passed it. Then, after going about fifty yards, he turned, saying to himself: "Well done, Pat, me bye. Come back and I'll treat ye."

* * *

One time a neighbor came over and wanted to borrow Grandpaw Snazzy's new rope and Grandpaw Snazzy says: "No, I've got to use that rope today to tie up some sand." After the neighbor left, I says, "Grandpaw Snazzy, you know you can't tie sand with a rope!" Grandpaw Snazzy says, "Remember, my boy, you can pret' near do anything with a piece of rope if you don't want to lend it."

* * *

"Tell the boss I'm here to see him," growled the big, broad-shouldered man to the slender office boy. "My name is Johnson."

"So you're Mr. Johnson," replied the boy, looking the tall man over. "How very awkward!"

Johnson: What'd you mean—awkward?

Boy: Why, sir, I've got orders to throw you out.

* * *

The first knock may be Opportunity, but the second may be the house detective.—*Texas Hotel News.*

* * *

Jealous Tramp (watching holiday crowds): I hates holidays.

Second Ditto: Same here. Makes yer feel common when nobody ain't workin'.

* * *

"Jack, do you know what good clean fun is?"

"I'll bite, Gracie, what good is it?"

* * *

Believe It or Not

These are towns in the United States: Ash, Kan.; Odear, Me.; Houdy, Miss.; Fiven, Tenn.; Kay, O.; Shoo, Fla.; Carpet, Tex.

Men are peculiar, just as women have long suspected. For instance, a fellow who hadn't kissed his wife in five years, shot a fellow who did.

* * *

Futile efforts have been made to get rid of pigeons who live on the ledges of the Capitols at Washington and Albany. The birds have a habit of putting into practice the suppressed desire of the irate tax-ridden citizen, relative to the general run of legislators.

—*DKE Quarterly.*

* * *

Bride: I would like to buy an easy chair for my husband.

Salesman: Morris?

Bride: No, Clarence.

* * *

Reasons Why

"Why is it you encourage all your clerks to get married?"

"Well," replied the knowing boss, "I find that married men are not in such an awful rush to go home early as single men."

* * *

Which Is It?

"My husband is the only man who ever kissed me."

"Are you bragging or complaining?"

* * *

Oscar came to the city and got a job as janitor in a girl's boarding school, and was entrusted with a pass key to every room in the building.

The following week the Dean ran across him and asked, "Why didn't you come around Friday for your pay, Oscar?"

"Vot! Do I get wages, too?"

* * *

The spinster, shocked by the language used by the two men repairing telephone wires near her home, wrote to the company to complain. The foreman was ordered to report the happening to his superior.

"Me and Bill Winterbottom were on this job," he reported. "I was up on the telephone pole and accidentally let hot lead fall on Bill and it went down his neck. Then he called up to me, 'You really must be more careful, Harry'."

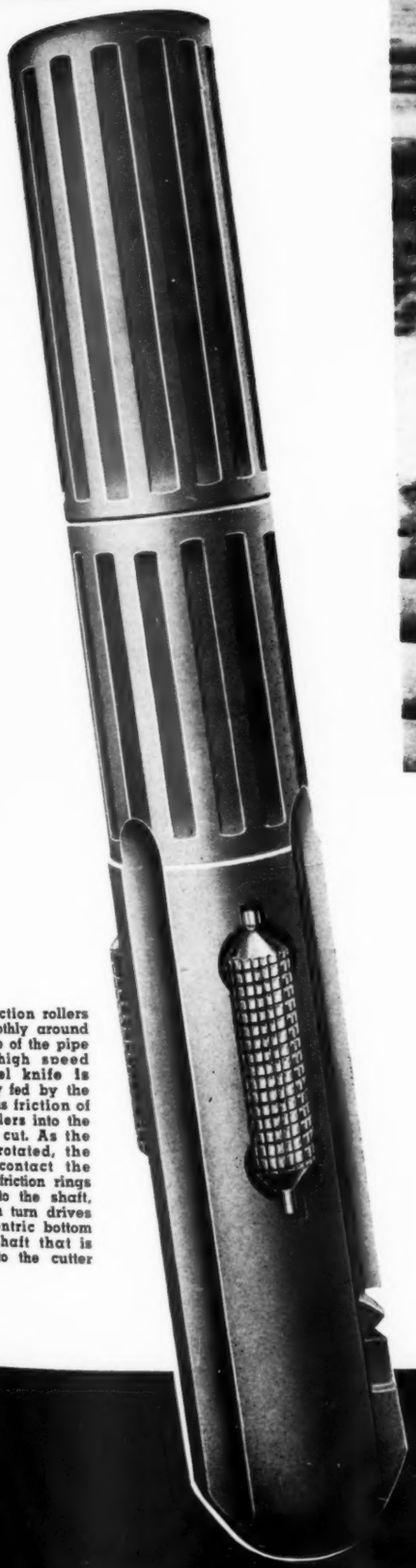
* * *

"Do you like short skirts, Mike?"

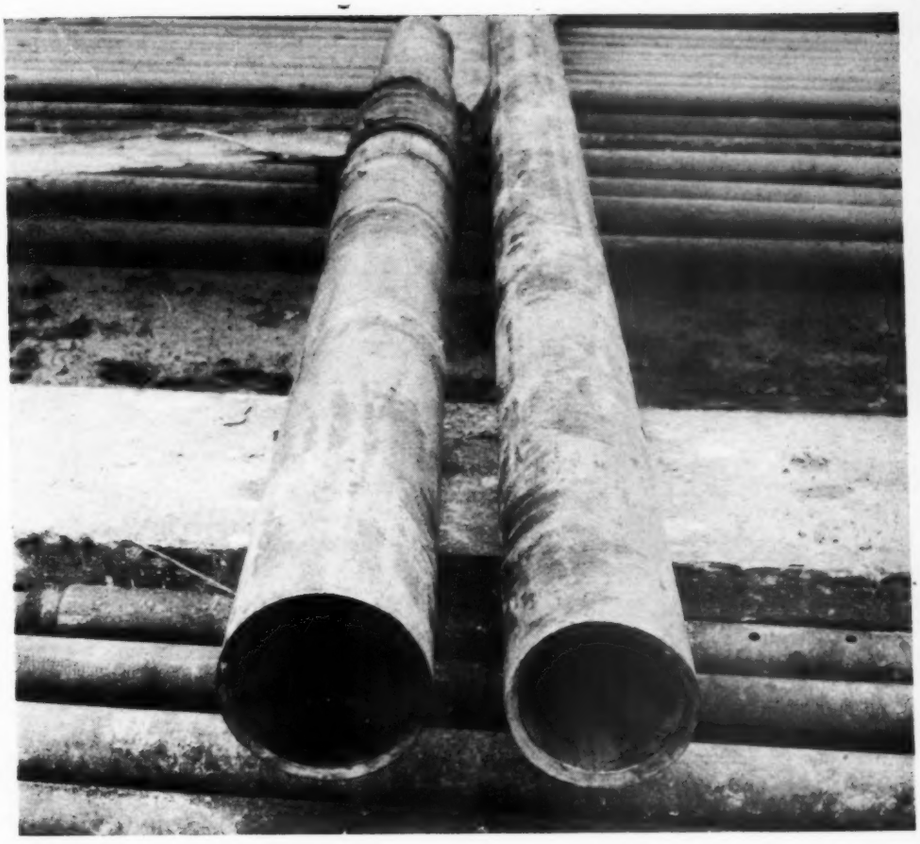
"Naw, they get lipstick on me shoit when I dance with them."

ABERCROMBIE'S INSIDE CUTTER

Cuts 'em Like a Lathe!



Three friction rollers ride smoothly around the inside of the pipe as the high speed tool steel knife is gradually fed by the continuous friction of these rollers into the point of cut. As the tool is rotated, the rollers contact the beveled friction rings splined to the shaft, which in turn drives the eccentric bottom of the shaft that is pinned to the cutter blade.



A smooth cut on the end of a piece of recovered pipe may not add to salvage values, but it proves the value of dependable cutting tool performance where the difference in success and failure means real money . . gained or lost!

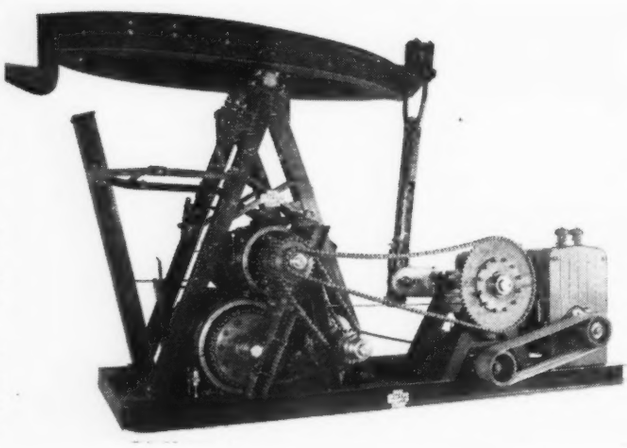
The Abercrombie Inside Cutter (shown at left) recently made a 5" liner cut at 3,350 feet on the Clemville, Texas, workover job pictured here; and recovered 300 feet, including liner packer. The cut made by Abercrombie Red Ball Service is reproduced above, alongside the lathe-cut end of the packer. You can see for yourself the results obtained by the Abercrombie Inside Cutter and the Red Ball Service Operator.

NOTE, at left, how the Abercrombie Inside Tool operates.

MACHINERY and EQUIPMENT

Shaffer Double Walking Beam Cable-Tool Unit

THE Shaffer Specialty Company, Tulsa, Oklahoma, announces a cable-tool servicing unit with standard beam action accomplished without switching lines or interfering with drilling and sand lines in any way.



This Shaffer portable servicing and drilling unit incorporates a new design in walking beams that overcomes the difficulty arising from the beam interfering with the lines passing back and forth across the face of the drums, the manufacturers state.

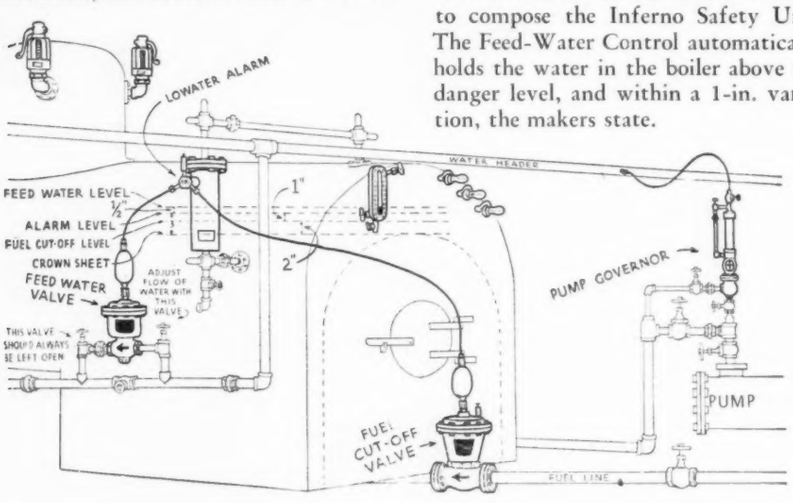
The Shaffer double walking beam includes two wide-flange I-beams joined at the crank and temper screw ends with an oval opening between the ends for free passage of the lines to permit spooling without disturbing the normal position of the beam.

The members are spaced to divide the load on two sampson posts, preventing twisting or misalignment of the beam. The Shaffer double walking beam, being mounted on double sampson posts independent of the drum jack posts, eliminates the shock load of the beam and prevents misalignment of drum-shafts or bearings, it is stated.

This portable unit is comparable in operation to conventional cable-tool units, providing a safe and efficient beam operation for drilling, the makers claim. The shock load of spudding over the derrick, as well as excessive wear on drilling lines, is eliminated by the Shaffer unit, it is stated. The unit can be used for rotary drilling by converting the crank shaft drive to the rotary table.

Inferno Feed-Water Control

SUPPLEMENTING its Lowater Alarm and Fuel Cut-off Valve, the Inferno Company at Shreveport, Louisiana, has added a third device to safeguard the operation of oil-country boilers. The new Inferno Feed-Water Control is used with the Inferno Lowater Alarm and Fuel Cut-Off Valve to compose the Inferno Safety Unit. The Feed-Water Control automatically holds the water in the boiler above the danger level, and within a 1-in. variation, the makers state.



Installation is made as indicated by the accompanying diagram. Three valves, operated successively by a monel metal float in the Lowater Alarm, serve to turn on first, the Feed-Water Control; second, the Lowater Alarm, if the water supply fails; and third, the Fuel Cut-Off Valve, if the alarm is not attended.

The new Feed-Water Control holds the water level 3½ in. and 4½ in. above the crown sheet. If the water supply fails, the Lowater Alarm sounds a warning when the water level falls to 3 in. above the crown sheet. If that warning is ignored, a further drop of 1 in. in the water level causes the Fuel Cut-Off Valve to close the fuel line and keep it closed until turned on by hand.

The Inferno Company has Bulletin No. 10 on the Feed-Water Control and the Complete Safety Unit available.

† "THE BUFFALO FAMILY"—by Charles M. Russell

The Price of Survival

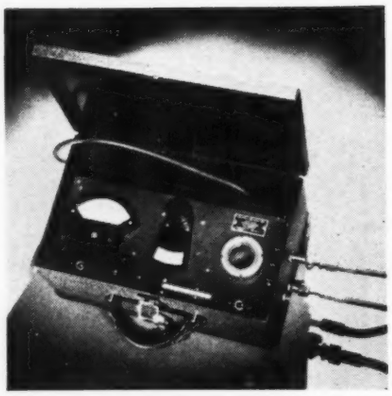
When Texas and Oklahoma symbolized the unfenced range, bison roamed where today the air is heavy with the throb of pumping wells. ☆ Leaders of the bison herd were bulls—sinewy of limb and strong of heart. In a ring, with lowered heads facing out, they successfully resisted the wolves' onslaught. In Summer they led the herd to water and green pastures—in Winter to valleys sheltered from the blizzard's blast. ☆ The buffalo bulls have crossed the Great Divide, but the watchful leadership they immortalized can never die. Manufacturing concerns supplying the oil industry with the sinews needed to wage their relentless war in wresting crude oil from the earth, carry on. Pledged to protect their consumers against products of inferior quality, watchful for unfair prices, aggressively seeking to design more efficient equipment, jealously striving to improve their service—they stand for the spirit of a new age. ☆ Axelson Manufacturing Company, who for forty-five years has subscribed to these principles, is proud to be numbered among these organizations. ☆ Axelson Manufacturing Company, P. O. Box 98, Vernon Station, Los Angeles. St. Louis. 50 Church Street, New York. Tulsa. Mid-Continent and Eastern Distributor: Frick-Reid Supply Corporation. Rocky Mountain Distributor: Great Northern Tool & Supply Company.

☆ ☆ ☆

† Few men have the knowledge and understanding of the West and its creatures as did Charles M. Russell. In this powerful bronze, he has caught the Buffalo family, contented after feeding, lying down to rest. The bull guards his cow and calf. This is the first time that permission has been granted for reproduction of this bronze. A reproduction of this picture, suitable for framing, is available upon request.

AXELSON PUMPS AND SUCKER RODS

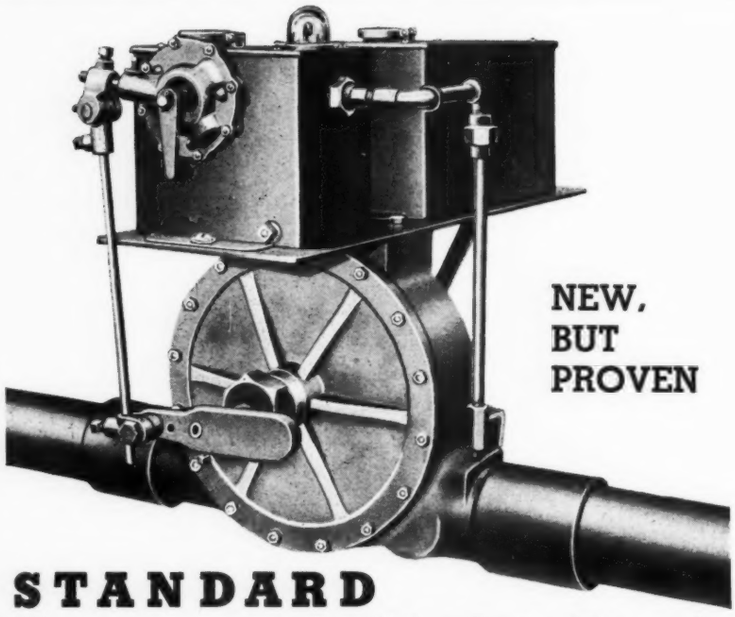
Dew-Point Potentiometer



FOR use in determination of moisture content of atmosphere in metal-heat-treating furnaces, the General Electric Company, Schenectady, New York, has developed a new portable dew-point potentiometer.

The instrument consists of a polished metallic mirror placed in a small chamber in such a manner that it can be seen through a sight glass, and means for cooling the mirror and reading its temperature. Gas to be tested is passed continuously through the chamber; and, as the temperature of the mirror is lowered by a jet of carbon dioxide or some other gas from a storage tank directed against the back of the mirror, a spot of dew appears when the dew-point temperature of the gas is reached. Formation of dew at the center of the mirror is very definite and is easily observed.

A light-gauge thermocouple and a balancing circuit, with direct-reading meter, allow accurate reading of the mirror temperature at the instant that the dew appears. This is the dew-point temperature of the gas being tested, and it enables conversion to the weight of water vapor per cu. ft. of gas, or other convenient unit. Range of dew-point temperatures of the instrument is from 130 deg. fahr. to minus 40 deg. fahrenheit.



NEW, BUT PROVEN

STANDARD
Force and Sight Feed
CHEMICAL INJECTOR

Designed for properly injecting chemical for treating oil, the new STANDARD automatic Chemical Injector embodies the many proven features of the STANDARD Lubricator so widely used today for the dependable lubrication of pumps, engines, compressors, and other oil country machinery.

The chemical is automatically pumped from a 7-quart chemical container by a regular STANDARD Lubricator, which is actuated through an impeller by the flow of oil in the line.

The unit delivers chemical into the oil stream according to adjustment by the operator . . from 1 drop every 30 revolutions, to 1 gallon in 7 hours at 10 revolutions per minute. The sight feed shows the exact amount of chemical being delivered.

Added to the STANDARD Lubricator is an auxiliary pump attachment for lubricating all working parts in a bath of oil.

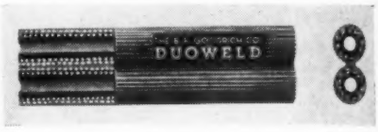
All parts are non-corrosive, including the ¼" pressed steel container and the ¼" pressed steel base.

AMERICAN LUBRICATOR COMPANY
DALLAS, TEXAS
EXPORT: OILWELL SUPPLY COMPANY

"STANDARD" LUBRICATORS

Duoweld Hose; Special Rope Wrapping for Oil Hose

A NEW oxy-acetylene hose, known as Duoweld, has been announced by The B. F. Goodrich Company, Akron, Ohio. It consists of two strands of ¼-in., 2-braid hose with corrugated cover molded together as a single unit. The cover on one strand is red, and the



other is green. This color distinction is adopted as an aid to the operator in distinguishing the acetylene from the oxygen line. Advantages claimed for this dual construction are that it prevents the two lengths of hose from becoming tangled with each other, eliminates kinking, and is less apt to snag on surrounding objects.

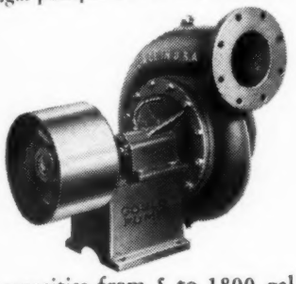
Goodrich Duoweld hose is offered in 12½-ft., 25-ft., and 50-ft. lengths. Each length is separated and secured with metal ferrules about a foot and a half from the ends for easy attachment to equipment.

Goodrich also announces special rope designed for use as a protective wrapping on oil suction and discharge hose. It is of braided construction and has a wire core. Whereas ordinary rope unwinds when cut and has a tendency to stretch and bunch up, this new Goodrich rope does neither, it is stated. The wire core serves to hold the rope firmly in place on the hose, and even if several strands of the rope are cut, the wire prevents it from unbraiding or from unwinding from the hose.

Goodrich rope for wrapping is available in ⅜-in. diameter only.

Goulds Centrifugal Pumps

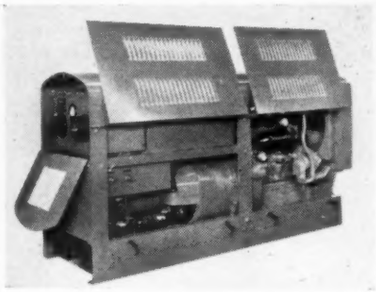
GOULDS PUMPS, Inc., Seneca Falls, New York, announces for 1938 a complete new line of single-stage, side-suction, ball-bearing centrifugal pumps. There are 18 sizes having capacities from 5 to 1800 gal. per min. against heads to 110 ft. for flat or V-belt or direct-motor drive. Modern hydraulic design is embodied in casings, impellers, and stuffing boxes. Structural strength and amply proportioned parts are provided without excess weight. Quality materials, ingenious design, and fine workmanship insure outstanding performance, trouble-free service, and long life, the manufacturers claim.



Goulds Bulletin No. 210 gives complete details, data tables, and all needed information.

Diesel Engine-Driven Arc-Welder

A new Diesel engine, which differs from the popular conception of this type of power in that it compares favorably with gasoline engines in simplicity, weight, and cost, as well as operating speed, has been adopted for driving arc-welding generators by engineers of The Lincoln Electric Company, Cleveland, Ohio, in collaboration with Diesel engine manufacturers.

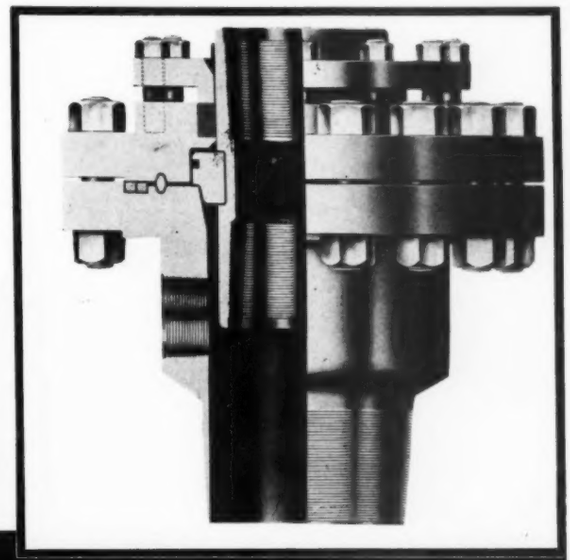


Engineers of the Lincoln Electric Company claim this new welder cuts fuel costs 33 percent to 86 percent, depending upon the price of fuel oil used. For instance, at full load operation, it uses only 1.5 gal. of fuel oil per hour, it is stated.

Maximum efficiency and service economy of the engine are assured by a new Diesel principle embodying patented combustion chambers, it is stated by the manufacturers. By accelerating turbulence of the fuel and air mixture, complete combustion is afforded, increasing efficiency, and minimizing smoke and noise, it is claimed; also, the position of this combustion chamber, relative to the piston, provides uniformly distributed pressure on the piston.

Other engine features claimed include: pintle-type fuel nozzles that are non-clogging and non-enlarging, assuring positive and uniform action; five filters (three fuel-oil filters, one oil-type air filter, and one lubricating oil filter) contribute to the efficiency and dependability of the engine; use of the required number of standard 6-volt automobile batteries for starting facilitates field service and replacement. Through a standard relay the exciter charges the batteries. The main welding generator is used to start the engine. The engine is a compact unit without extras such as a starter motor, generator, and special controls.

The arc-welding generator used on the new Diesel engine-driven welding machine is the 300-amp. "Shield-Arc SAE" unit equipped with dual-continuous control.



HAMMER FORGED STEEL

See Our Exhibit
INTERNATIONAL PETROLEUM EXPOSITION
TULSA
MAY. 14-21

The nickel chrome alloy of which hammer forged RECTORHEADS are constructed exceeds in all physical properties the A.P.I. requirements for their working pressures. This material further has that uniformity of texture and freedom from any possible defects assured only in hammer forged steel. Operators who specify hammer forged RECTORHEADS (Types "EH," "AH," and "H") know that they are safely meeting the hazards of modern-day drilling and producing, and in addition are providing definite protection to their well investment.

RECTOR

M. I. W. Enters Pumping Equipment Field

MUSKOGEE Iron Works, Muskogee, Oklahoma, pioneer Mid-Continent steel fabricator and derrick manufacturer, announces its M.I.W. line of double-reduction twin-crank pumping units. The M.I.W. units are made in six structural sizes and eight sizes of gear boxes. The polish rod load capacities range from 10,000 lb. to 27,500 pounds. The double-reduction herringbone-gear units have capacities from 10 to 50 horsepower.

One of the advantages claimed for the Muskogee units is the interchangeable feature. Several sizes of gear boxes can be used with each size of structural. This feature permits the selection of a combination suited to existing well conditions. If the well conditions change, it is possible to replace the gear box and engine with a more suitable size.

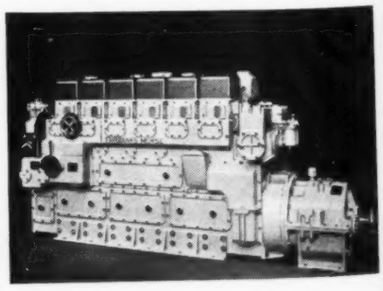
In addition to the interchangeable feature, the entire units are designed with liberal factors of safety, the manufacturers state. All plain bearings are designed with allowable bearing pressures as specified by the A.P.I. The self-aligning SKF wrist pin bearings are selected for a life of approximately ten years. All parts are built with welding and drilling jigs. The complete unit is assembled and run in before it is shipped from the factory.

Pumping Equipment Bulletin P-1, recently released, gives specifications and capacities of the various combinations in detail. Specific recommendations, installation prints, and additional information will be gladly supplied by the manufacturer.

Fairbanks-Morse Convertible Gas and Diesel Engine

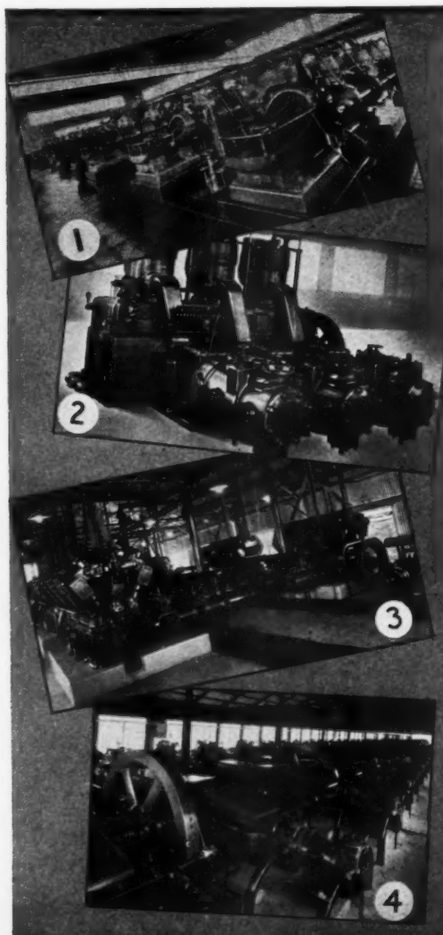
FAIRBANKS, MORSE and Company has announced a series of 4-cycle, vertical, convertible Diesel and gas engines. This new Model 36-A-8 size provides a sturdy, medium-speed engine in the 200- or 300-hp. range, state the manufacturers. Built in both 6- and 8-cylinder combinations, with 8-in. bore and 10½-in. stroke, they develop 35 hp. per cylinder at 720 revolutions per minute. Smaller sizes of Model 36-A Diesel are available in ratings as low as eight horsepower.

Both Diesel and gas engines in the new 8-in. cylinder size are offered for



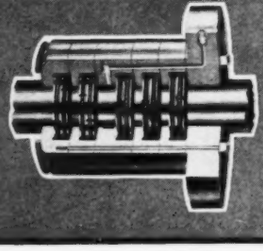
stationary service, and the Diesels are offered for marine propulsion and in complete, unit-built Fairbanks-Morse generating sets as well. The Diesels for

Seal your reciprocating piston rods
the way so many engine and compressor operators do... with
COOK'S METALLIC PACKINGS



Wherever you may look throughout the oil and gas fields you will find COOK'S Metallic Packings predominating on the power and compressor rods of gas pumping and gasoline extraction engines. Noteworthy applications are represented by the engines, shown in the accompanying illustrations, that come factory equipped with COOK'S modern Packings.

Make sure you get the genuine COOK'S Packings when buying new equipment by specifying their use. For existing equipment communicate with us direct, or our nearest branch office.



1-COOPER-BESSEMER CORP.
2-CLARK BROTHERS COMPANY
3-INGERSOLL-RAND COMPANY
4-WORTHINGTON P&M CORP.

C. LEE COOK
MANUFACTURING CO.
INCORPORATED
LOUISVILLE, KY.
NEW YORK • LOS ANGELES • CHICAGO
NEW ORLEANS • CLEVELAND • TULSA
BALTIMORE • SAN FRANCISCO

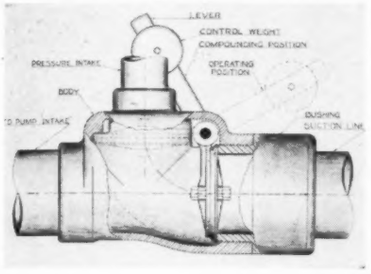
marine service are direct-reversible, but can be supplied as non-reversible.

Enbloc construction is employed, and the engines have individual cylinder liners, precision main, connecting-rod, and camshaft bearings, and suspended or "underslung" crankshaft. Side cover-plates permit easy accessibility to main and connecting-rod bearings. The design permits double-end drive or power take-off from either end, a distinct advantage in certain types of application.

Additional information can be obtained by writing on a business letterhead for Bulletin 3600-A-3 to Fairbanks, Morse and Company, 600 South Michigan Avenue, Chicago, Illinois.

Automatic Compound Suction Valve

A NEW automatic compound suction valve, designed to compound slush pumps for drilling wells by rotary



method, is announced by the American Iron and Machine Works Company, Oklahoma City, Oklahoma. The valve is used when blowouts are encountered in drilling wells and when blowouts would have to be mudded off by creating compound pressures of both pumps. It is also very useful in pumping down cement or other substances when extreme pump pressure is required, it is stated. The American Compound Suction Valve is made of the best grade of steel and has a safety factor in excess of actual requirements, the manufacturers state.

Small-Size Mud Screen

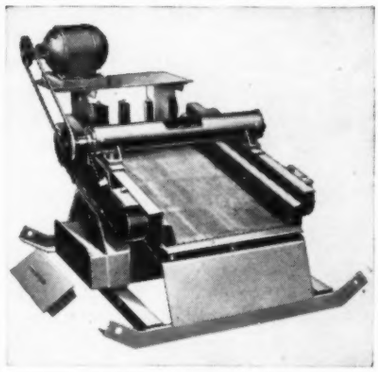
LINK-BELT Company, Philadelphia, Los Angeles, and Houston, announce they have perfected and are now offering the oil industry a new small-size improved vibrating screen, known as Type NRM-124, for reconditioning rotary mud.

Among the features of this new screen, the manufacturers have set forth the following:

Clear unobstructed screening deck, measuring 2 ft. wide and 4 ft. long.

Improved manner of securing stainless steel screen cloth assures uniform tension.

Tubular rubber cushioning of uniformly stretched screen cloth assures dry rejects and maximum life of cloth.



Fully enclosed vibrator unit, and sturdy platform-spring suspension of screen box, which is vibrated uniformly.

Adjustable wing deflectors assure good distribution of mud over screening surface.

Unitized mud tank skidded and complete with motor supports, making for ease in moving screening unit from one location to another.

Trough connection or outlet for screened mud is provided on either or both sides of screen box.

SUPERIOR SERVCE

Wherever you turn

The patented construction of the Chiksan Swing Joint sets it apart from all other types of flexible connections. Its double rows of hardened steel balls not only carry all radial loads, but also maintain a pre-regulated thrust load upon the packing element, keeping it always pressure tight and leak proof. The joint cannot bind . . . it cannot get out of adjustment . . . and there's nothing to interfere with free and complete 360 degree swiveling.

CHIKSAN ALL-STEEL ROTARY HOSE—

Seven Chiksan Swing Joints give seventeen swivel movements to assure complete flexibility. All steel construction means complete safety at all pressures and makes this hose ideal for both pressure drilling and ordinary drilling. Patented Neoprene packing elements are resistant to all petroleum products and assure superior performance, whether circulating with mud or oil.

CHIKSAN CIRCULATING HEAD ("Poor Boy's" Swivel)

A light auxiliary swivel that has a multitude of uses around a rig. It allows complete rotation in both horizontal and vertical planes and has a tee connection for running wire line instruments.

CHIKSAN MUD MIXING GUN

This gun features complete 360 degree rotation in both vertical and horizontal planes, and can be moved from rig to rig with a great saving in time and a tremendous increase in efficiency. Made with a fire hose type nozzle and a substantial handle is provided for easy operation which can be locked in any position.

CHIKSAN OIL TOOL CO., LTD.

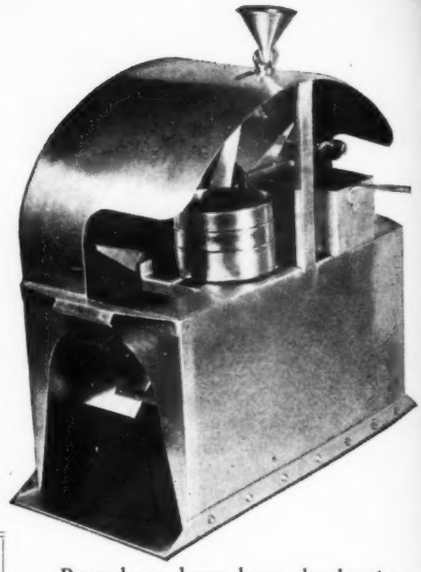
FULLERTON, CALIFORNIA • PHONE 1254
BAKERSFIELD, CALIFORNIA • PHONE 5576
GULF ENGINEERS • HOUSTON, TEXAS

CHIKSAN *ball bearing* SWING JOINTS

Automatic Mud Sampler

THE Hayward Automatic Mud Sampler has been designed to overcome many objectionable features connected with obtaining samples from rotary-drilled wells. The paddle wheel is turned by the flow of mud in the trough, and the wheel mounting, being practically frictionless, revolves at a rate that is almost equal to that of the mud. A spoon, or dipper, picks up a small sample of the mud at every revolution and spills it into the two containers. The first container receives the first material spilled from the spoon (which material is largely liquid), and this sample, which is truly representative, is used for the various physical tests to be made upon the mud.

The second container consists of a nest of screens, and receives the second half of the contents of the spoon. A continuous small stream of water, intercepted by the spoon in its revolution, washes the heaviest solids out of it, and also washes the cuttings already deposited in the screens. These cuttings, being obtained automatically, continuously, and proportionately, provide considerable information, and can be used for correlation purposes, in many instances reducing the amount of coring necessary.



Procedures have been developed in connection with the mud sampler for determining vital geological information.

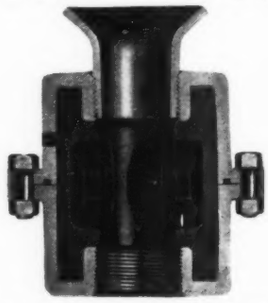
It has been found possible to pick up oil and gas sands, even though only two or three ft. thick, with the mud sampler, the manufacturers claim.

The overall dimensions of the machine are: length, 33 in.; width, 13¾ in.; height, 28 inches. It weighs 86 pounds.

Lucey Products Corporation, 910 South Boston, Tulsa, Oklahoma, are distributors of the Hayward Automatic Mud Sampler.

Development in Sucker Rod Wipers

A DEVELOPMENT in sucker rod wipers is announced by the Regan Forge and Engineering Company, San Pedro, California. They have adapted the Type K blowout preventer body in the 3-in. size for this service.



The body is equipped with a special soft rubber of oil-resistant stock operable with 45-lb. to 60-lb. air or gas pressure. Operations such as water witching, surveying, stratigraphing, paraffin removal while producing, polish rod packing, and swabbing are safely performed through the tool. Rods, couplings, and wrench squares are stripped clean and the plunger may be bumped through and wiped, according to the manufacturers. The wiper gives a clear passage of 3-in. diameter and both ends of the body are tapped for 3-in. line pipe.

See Our Exhibit
INTERNATIONAL PETROLEUM EXPOSITION
TULSA
MAY. 14-21

UP-CUTTING
QUICK-CUTTING
COST-CUTTING

SPANG ECLIPSE
WIRE ROPE KNIFE

When you use the Spang Eclipse Wire Rope Knife, it usually takes but one or two blows to cut the line. That's because both the knife and the anvil (A and E, respectively, on the illustration) are hardened, insuring a quick, clean cut with minimum effort.

Consult SPANG about any cable-system drilling or fishing problem that arises.

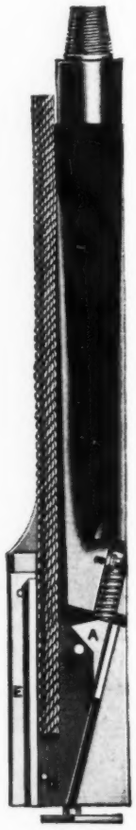


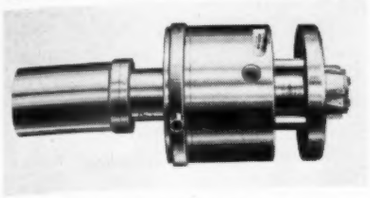
Fig. 671

SPANG & COMPANY • BUTLER, PA.

Specify Spang
"HIGHER-STANDARD" CABLE TOOLS

Landis 3ALM Receding Chaser Collapsible Tap

THE Landis Machine Company, Waynesboro, Pennsylvania, announce a new addition to their line of collapsible and receding chaser collapsible taps. The Landis 3ALM is a



tap of the receding chaser type possessing a number of features that greatly increase the efficiency of its performance, both in the accuracy of the threads it produces and in the length of life of the chaser between grinds, the manufacturers state.

The 3ALM tap, designed primarily for the tapping of couplings, etc., may be applied to any machine employing a live spindle and on which the resetting is done automatically. There is no manually-operated model.

The internal mechanism of this tap is similar to the standard LM tap in that it employs a cross-slide cam to control the taper. It is possible to trip the tap at any position by merely adjusting a tripping bar so that it contacts the tripping "button" situated in the body of the tap near the shank end.

An extremely simple adjustment is provided for taper change and for taper correction. This tap may be used for any taper of thread ranging from 0, or straight threads, to ¾-in. taper per ft. and may be changed by degrees. To change taper or to adjust for a slight error it is necessary merely to release a locking screw in the control collar and move the taper indicator.

Another feature of the 3ALM tap is the method by which the cutting cooling medium is directed to the cutting edges of the chaser, designed to assure greater tool life and a better quality of thread.

The range of the 3ALM tap is 2 in. to 4 in., inclusive, and the same tap heads may be employed that are used on the standard 4LM receding chaser tap.

Recording Chart Ink

A NEW recording chart ink has been developed by the Permochart Company, of Pittsburgh, Pennsylvania, after more than six months of laboratory research, especially for use on the renewable permanent recording charts manufactured by this company.

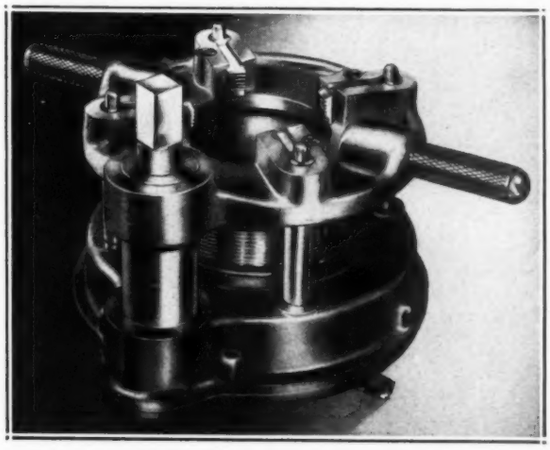
Every plant engineer knows the inconvenience caused by ink that clogs the pen and refuses to flow, the damage done by ink that floods and smudges the chart, the inaccuracy of ink lines that spread and "feather," the exasperation of having to refill pens that have gone dry during the course of a test or check run.

Advantages claimed for the new chart ink are that it starts flowing instantly and easily but does not flood; that it will not cake on the pens even if they run dry and are left so for several days; that it dries quickly and does not smudge or spread. Records of 50 hours duration or more have been made from one filling of the pen.

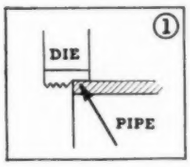
Permochart recording chart ink is made in three colors; purple, red, and green, the first being recommended by the manufacturer as giving the best contrast with the natural color of the Permochart. It is available in two- and eight-ounce bottles.

The smooth, hard, non-absorbing surface of the Permochart, according to the manufacturer, provides a perfect writing surface for the pen, from which the new ink flows in a uniformly sharp, clear line insuring easy and accurate readings. Damage from pen penetration, to which paper charts used with ordinary inks are subject, is said to be entirely eliminated.

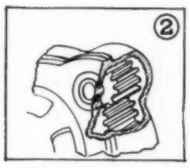
The New Beaver-"48-R"



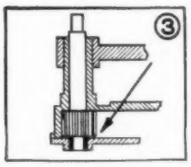
2½" to 4"—4 Sets of Dies—Fully Enclosed Gears With Five Important Improvements!



1. Extra wide die—with wide throat centers and holds tool in position when placed on pipe.

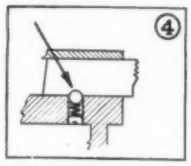


2. Fully-enclosed gears; save costly repair bills!

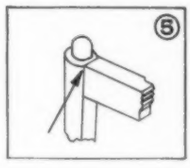


3. Straddle-mounted pinion; an exclusive Beaver advantage, eliminates repairs.

4. Dies held in position by a fully-enclosed dirt-proof spring-backed ball.



5. Shoulder on posts for quick, accurate die setting even under poor light.



Semi-Adjustable
Weight 58 Pounds
Price, $50.00

Through Your Jobber

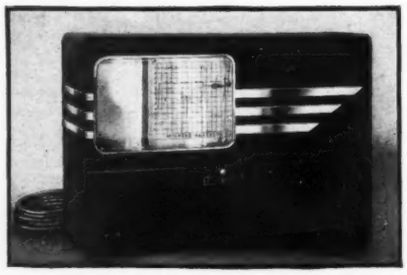
BEAVER PIPE TOOLS

338 PETROL AVENUE WARREN, OHIO

Remote pH Recorder With Glass Electrode

WHAT is said to be the first automatic pH recorder using a glass electrode was installed recently by the Wilkens-Anderson Company of Chicago, Illinois. The recorder is known as the Cameron pH Recorder and patent application has been filed.

Because the glass electrode is the only one that may be used in the presence of gaseous, oxidizing, or reducing liquors, application of automatic pH recording and processing is now possible, it is stated. Thus, the recorder may be used for a permanent record of the pH of the water from the separator.



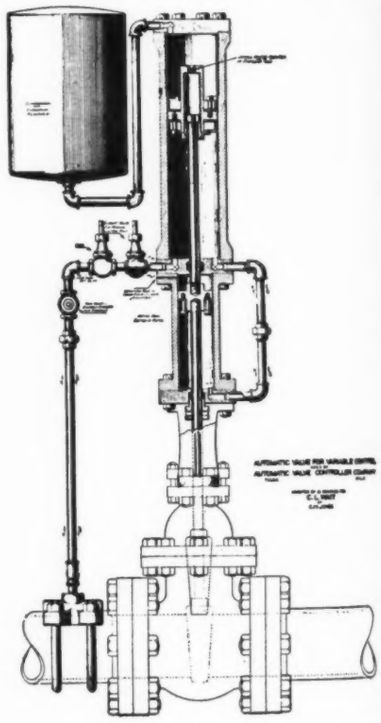
Only the sampling mechanism and electrodes are located in the plant. The pH record is written in the privacy of the superintendent's office.

With glass electrodes mounted at three points, where pH record is required, samplers (valves operated by an electric clock) automatically withdraw samples at fixed intervals, the frequency of which may be changed to meet specific needs. The potential developed by the electrodes is transmitted through about 50 ft. of cable to the automatic recorder.

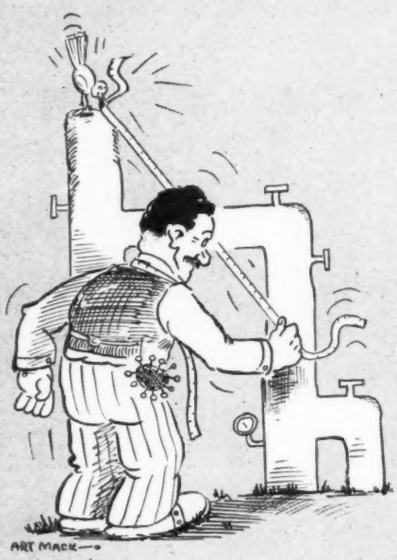
Processing valves also may be operated and handled by a modification of the Cameron Recorder, it is stated. In effect, this permits automatic titration, holding the liquids of a process at any predetermined pH value.

Automatic Valve Control

THE Automatic Valve Controller Company, Cosden Building, Tulsa, Oklahoma, has placed on the market an automatic valve control that handles various loads of more than 25-lb. pressure in gas and liquid lines.



This control remains open during normal demand and automatically closes when sudden drop of pressure occurs, its makers state, keeping the valve closed until pumping is resumed. Provision has been made to keep the line from closing during a slow decrease in the line pressure. The control is adaptable to every pipe line need under all conditions, single and double lines, and river crossings, the manufacturers say.



Several types of Merla Flow Valves and the efficient flexibility of the Merla operating principle make it possible to fit Merla installations to the characteristics of various wells as precisely as a clothier fits customers.

The "why" of this is explained in the Merla Booklet, a copy of which will be mailed upon request.

MERLA TOOL COMPANY

Manufacturers of Oil Field Equipment

P. O. Box 2576 Dallas, Texas

MERLA

Gas Lift

FLOW VALVE

TUBING FLOW CASING FLOW INTERMITTERS

Eagle-Picher Appoints New Distributors

The following ten companies recently were approved by the Eagle-Picher Sales Company, Cincinnati, Ohio, as distributors for the Eagle-Picher line of industrial insulating materials: Automatic Coal Burner Company, Beckley, West Virginia; Bemis Refractories Service Company, Springfield, Massachusetts; The Corbett-Wallace Corporation, Houston, Texas; Joseph A. Coy Company, Tulsa, Oklahoma; The G. M. Hardware Company, Beaumont, Texas; H. R. Kelly Company, Inc., Brooklyn, New York; Fred H. McGee, Chattanooga, Tennessee; McLean-Peterson Company, Cincinnati, Ohio; United Brick and Tile Company, Oklahoma City, Oklahoma; and United Engineering and Equipment Company, Nashville, Tennessee.

Included in the Eagle-Picher line are plastic insulation, blanket and fill insulation, pipe insulation for either indoors or outdoors, blocks, and waterproofing compounds.

Texas Electric Steel Casting Company Expands

Texas Electric Steel Casting Company, Houston, Texas, has begun an expansion program that will double the capacity of the plant's steel casting output. Included in this program is the addition of 8320 sq. ft. of floor space to the building, a 1½-ton electric furnace, an electric crane, an annealing furnace, additional core ovens, and other necessary equipment. All equipment has been purchased, and construction is being rushed to completion to take care of the increased volume of business the Tesco foundry has contracted. During 1937 Tesco poured 10,000,000 lb. of steel for oil-industry equipment alone, officials of the company state.

International Opens at Kemp City and Fittstown

International Supply Company announce the opening of two new stores, at Kemp City, Texas, to serve the K.M.A. field, and at Fittstown, Oklahoma. The Kemp City store is south of Electra and southwest of Wichita Falls. P. J. Ryan is manager. The store offers telephone and motor freight service, and mail and telegrams will clear through Electra.

The Ada, Oklahoma, store of the company has been moved to Fittstown and M. L. Creed has been transferred to that point as manager. The Fittstown telephone is 99 Fittstown, and mail and telegrams will be handled through Ada.

Assign Territories to New Salesmen

Manning, Maxwell and Moore, Inc., Bridgeport, Connecticut, makers of valves, gauges, safety valves, thermometers, and control instruments, announce the assignment of nine new general field salesmen to territories.

New territories have been created with salesmen and headquarters as follows to serve them: Charlotte, North Carolina, Paul Hayden; Jacksonville, Florida, W. H. Kissam; New Orleans, Louisiana, R. F. Heath; Minneapolis, Minnesota, K. W. Johansson; Columbus, Ohio, W. S. Adams.

The following territories where the company already has an office are being strengthened by the following salesmen: New York City, V. W. Farris; Philadelphia, H. H. Jones; Chicago, H. B. Stallings; and Tulsa, C. W. Velie.

Two new district sales managers are also announced as a part of this sales force expansion. R. W. Neel, who has represented Manning, Maxwell and Moore for a number of years, is now in charge of the newly-created southeastern district with headquarters in Atlanta. Malcolm Black has been made manager of the southwestern district with headquarters in Tulsa.

Going straight down . . .
COSTS COME DOWN, TOO,
WITH THESE THREE SURVEYING DEVICES

1 Self-Checking SURWEL GYROSCOPIC CLINOGRAPH

"SURWEL" provides a map of the complete course of the well prepared from actual photographic records. It automatically makes two surveys at greatest speed, one going in and one while coming out of the hole.
Time required for making two surveys of a 6000 ft. hole on the wire line about two hours, on the drill pipe about four hours. (U. S. Patents 1,124,068; 1,812,994; 1,898,473; 1,959,141; 1,960,038; 2,006,556; 2,012,138; 2,012,152; 2,012,455; 2,012,456 and others pending.)

2. Self-Checking H-K CLINOGRAPH
(Hewitt-Kuster)

"H-K" designed for open holes only—provides permanent, accurate, photographic records of inclination and direction on paper discs five minutes after removing instruments from hole. (U. S. Patents 1,812,994; 2,027,642; 2,093,128 and others pending.)

3. Self-Checking SYFO CLINOGRAPH

"S Y F O"—used on a wire line, as a "Go-Devil" inside the drill stem, or on sand or bailing line in open hole—affords quick, inexpensive daily records of vertical deviation in drilling, without the use of dangerous acids. (U. S. Patents 1,962,634; 2,013,875 and others pending.)

A New Service that Saves Time and Money
CORE ORIENTATION SERVICE

SPERRY-SUN'S Polar Core Orientation (U. S. Patents 1,792,639; 1,778,981; 2,089,216; 2,104,752 and others pending) does not interfere with the progress of drilling. The orientation is determined in our laboratory, to which the selected cores taken by any type of core barrel in the ordinary course of drilling and properly marked, are shipped from any distances. No special equipment is required at the well, there is no loss of drilling time.

SPERRY-SUN WELL SURVEYING COMPANY
1608 Walnut Street, Philadelphia, Pa.

Tulsa, Oklahoma — 435 Petroleum Bldg.
Houston, Texas — 5118 Blodgett Avenue
Corpus Christi, Texas — 332 N. Morningside Drive
Long Beach, Calif. — 349 E. Ocean Blvd. (5800 Block Atlantic Avenue)
Bakersfield, Calif. — c/o Elks Club, 17th and I Streets
Lafayette, La. — Bank of Lafayette Bldg.

Petroleum Fluid Metering Conference

The school of Mechanical Engineering, University of Oklahoma, is cooperating with the Petroleum Division of the American Society of Mechanical Engineers in arranging the program for a "Conference on the Metering of Crude Oil and its Products." The Conference will be held at the University of Oklahoma, April 7th and 8th, 1938, and anyone interested in the metering of oil may attend.

During the two-day meeting there will be four sessions with discussions and papers on the following subjects:

THURSDAY, APRIL 7

Morning—"The various types of meters and the principles involved in the metering of crude oil."

Afternoon—"The metering of crude oil as related to pipe-line flow."

FRIDAY, APRIL 8

Morning—"The metering of petroleum and its products in the refinery."

Afternoon—"Metering as related to the production branch of the industry."

The men who will present the papers will be selected from qualified engineers of the industry and from the University staff.

Meter manufacturers have been invited to display sectional models of their equipment.

219,000 LBS. OF TWISTING STEEL IS A BIG CONTROL PROBLEM

but QUINTUPLEX handles it perfectly

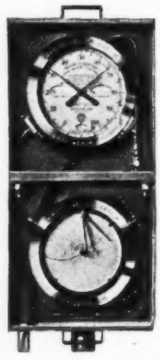
WHEN Continental's record well drilled through 13,700 feet they were still using 3½"—16-pound drill pipe. That's *more than Two Hundred and Nineteen THOUSAND pounds* of twisting steel to hold on the nose!

At that tremendous depth steel pipe is as flexible as wire, and weight on bottom becomes an extremely critical factor. Imagine, then, the precise control necessary to hold that string on a vertical course, and yet maintain proper drilling progress.

Continental picked the Quintuplex for this ticklish job, and are able to control the weight on bottom so carefully *two and a half miles away* that they not only have held the hole beneath the derrick floor, but have set a new speed record while doing it!

That IS control.

Whether drilling deep or shallow wells you want that kind of drilling control . . . and that's exactly the kind you get in *every* Quintuplex!



Do you Know 13,700 feet of 3½" drill pipe bears the same diameter-length ratio as more than an ⅛ of a mile of ordinary insulated light wire.

THE WEIGHT INDICATOR

MARTIN-DECKER CORPORATION

LONG BEACH CALIFORNIA

San Joaquin Valley: A. F. McQUISTON, Bakersfield, California

Mid-Continent Distributor: REED ROLLER BIT COMPANY, Houston, Texas

New Oil-Well Servicing Company Organized

J. G. (Jimmie) Greathouse, formerly with the Houston Oil Field Material Company, Houston, Texas, has gone into the oil-well servicing business with A. H. Masiran. Their headquarters are at 736 Nixon Building, Corpus Christi, Texas. The name of the company is the Complete Oil Well Service, Inc.

S. Mensonides Makes Trip Through East

S. Mensonides, vice-president in charge of oil field sales for Farrar and Trefts, Inc., has returned from a two months' trip in the East, where he visited eastern oil fields and the company's home office in Buffalo, New York.

S. MENSONIDES

Mensonides, well-known in the oil industry, has offices with the Continental Supply Company in Dallas.

Meeting Date for Eastern District Session A.P.I. Changed

Dates for the spring meeting of the Eastern District of the American Petroleum Institute's Division of Production have been advanced to April 14 and 15 from April 28 and 29, it has been announced by F. E. Eckert, district chairman. The change was necessitated by conflict in hotel arrangements.

Sessions will be held in the William Penn Hotel at Pittsburgh, Pennsylvania, and those who already have made reservations are being advised to confirm them for the new meeting dates. The program will be announced shortly.

James W. Sloan, Prominent in Petroleum Industry, Passes Away

James W. Sloan, Tulsa, Oklahoma, president of the International Supply Company, died at his home on February 21 from a heart ailment. He also was president of the Oklahoma Iron Works, president of the Bradshaw Oil Company, and vice-president of the Thompson Oil Company.

Sloan was born in Allegheny, Pennsylvania, in 1870, and had been active in the petroleum industry for more

JAMES W. SLOAN

than 40 years. His first affiliation with the oil business was in Pennsylvania. Later he went to Texas where he was in the employ of the Producers Oil Company. Subsequently he formed the Sour Lake Tool Company at Corsicana. In 1904 he moved to Oklahoma and formed the Cleveland Tool Company at Cleveland, Oklahoma. In 1906 he moved to Tulsa and purchased a foundry that he called the Tulsa Foundry Company. The Oklahoma Iron Works was organized in 1907, and in March, 1937, that company was affiliated with the International Supply Company.

Surviving are his widow, Mrs. Rose Sloan; a son, John Walter; a sister, Mrs. Mollie Sloan; and five daughters, Mary Katherine, Frances Rosalind, Martha Jean, Margaret Helen, and Patricia Ruth.

Patent Held Infringed

In an opinion handed down by Federal District Judge Harry A. Hollzer at Los Angeles, California, U. S. patent No. 1,467,831, relating to a process for removing water and emulsion from crude petroleum oil by means of chemicals, was found to be valid and infringed. The opinion was given in the case of The Tretolite Company et al., plaintiffs, vs. Research Products Company, Ltd., et al., defendants. This suit was filed in November, 1933, and was tried before U. S. Commissioner David B. Head, sitting as special master, in 1936. The particular reagent used by the defendants is known as "Hydrate 488."

The opinion confirms the findings and conclusions contained in the master's report, which was filed in 1935. Judge Hollzer's opinion states:

"The Court concludes for the reasons herein set forth, as well as upon the grounds stated in the master's report, that the exceptions taken by the defendants to the master's findings and report should be overruled and that a decree should be awarded to plaintiffs as recommended by the master."

The master's report recommended that "a decree be entered in accordance with the foregoing conclusions, that an injunction be issued restraining the defendants from the acts found to infringe Letters Patent No. 1,467,831 and that an accounting of profits and damages be had."

The chemicals involved in this decision are in wide use in the oil fields of the world for breaking crude oil emulsions.

A
SLUGGISH
PRODUCTION
PULSE
is
DUCK SOUP
for
DOC CAVINS
Run a
CAVINS
INTERNATIONAL PETROLEUM EXPOSITION
TULSA
M.D.
When it looks as though your production is going to die on the vine, call in "Doc" Cavins with his repertoire of modern clean-out specialties. He's on the job twenty-four hours a day with a staff of competent assistants located at strategic points in the major oil producing states.
The Cavins Automatic Hydraulic Suction Bailer is in a class by itself when it comes to cleaning out sand, shale, lime, junk, etc., and flushing the producing horizon clean of contaminating accumulations.
The Cavins Perforation Washer or the Cavins Screen Cleaner will give your wells the break they need to make their normal production.
CAVINS
THE CAVINS COMPANY
2853-2873 Cherry Ave. » Long Beach, California
Cable Address . . . . . "Cavins, Long Beach"
Foreign Representative . . . . . R. J. Eiche
BRANCHES
CALIFORNIA: Bakersfield, Taft, Ventura; TEXAS: Houston, Kilgore, Odessa, Big Spring, Monahans, Pampa, Graham, Wichita Falls; OKLAHOMA: Ada, Healdton, Perry; NEW MEXICO: Eunice; San Fernando, TRINIDAD, B. W. I.
(BAILER)
(UP-TRIP)
(PACK-OFF SHOE)

Refiners Ask Credits on Insurance Premiums for Inspection Service

For several years refiners operating cracking plants have felt that the fire insurance rates on cracking plants have been excessive. Some six or seven years ago the Universal Oil Products Company, owner of the Dubbs cracking patents, acting in coöperation with its licensees, began to assemble information on the experience of its licensees and these records reveal the following facts:

That during the seven-year period ending January 1, 1936, insurance companies collected premiums from cracking plant operators amounting to $1,807,265, which represented an average rate of $1.37 per $100 of insured value.

That during this same period losses were paid as a result of fire damage to cracking plants of $287,186, or a loss ratio of 15.89 percent and this experience has continued to the present date.

It is a generally accepted rule that fire insurance companies, in order to maintain their solvency, to pay a return on capital invested, and to fulfill the purpose for which they are created, that is, to pay losses, should collect from property owners as a premium, approximately twice the expected amount of losses that will be paid, the division of this premium that is collected being as follows:

50 percent to pay loss,

45 percent for expenses, taxes, etc.

5 percent for underwriting profit.

Executives in the refining industry, realizing that of the premiums they are paying only 15.89 percent is being used to pay losses whereas the normal loss ratio based on the above fundamental rule should amount to 50 percent of the premiums paid, have long felt that they were paying excessive premiums for fire insurance coverage on cracking plants.

On July 14, 1937, a meeting of cracking plant operators of the State of Texas was held in Fort Worth, at which time a committee was appointed to prepare a complaint and appeal to be filed with the State Fire Insurance Commission of Texas, at Austin, asking for lower rates on oil refineries operating cracking plants, and Roy B. Jones, of the Panhandle Refining Company, Wichita Falls, Texas, was elected chairman of this committee, which included the following representatives of Texas oil refineries: W. D. Richardson, Cosden Oil Corporation, Fort Worth, Texas; Ray Woolf, Shamrock Oil and Gas Corporation, Amarillo, Texas; Ben P. Piepgrass, Solvex Refineries, Tulsa, Oklahoma; Capt. J. F. Lucey, Talco Asphalt & Refining Co., Mount Pleasant, Texas; R. E. Hall, McMurray Petroleum Corporation, Tyler, Texas; and J. D. Bright, Waggoner Refining Company, Vernon, Texas.

This committee has just filed its complaint and appeal with the Texas Fire Insurance Commission, which gives complete information on safety measures that are in effect in the operation of cracking plants and complete information on the past history of fire losses as compared with premiums collected, and it hopes to be able to obtain for cracking plant operators substantial credits on existing insurance rates.

In the appeal the Texas refiners do not ask for any change in the present basic insurance rates; instead they ask that credits be given for a highly technical and efficient independent inspection service on cracking plants. This inspection service has been in effect continuously and has been paid for by the operators of the plants with a view to reducing the fire hazard and consequently they feel that credits should be allowed for this inspection service, which in reality is the only effective way of preventing explosions and resultant fires in cracking plants.

WHEN YOU HAVE 1" TO 2" PIPE TO THREAD—

Mister—you need a 1BR

The "TOLEDO" No. 1BR, the perfected 1" to 2" ratchet threader, uses a separate set of dies for each size. 2" dies made from high-speed steel. No bushings needed with new type long-life pipe holder. Three broad-faced chuck jaws operated by large wing-head thumb screws and size-marked guide bars make for easy, accurate centering.

Easy Operating . . Long Life . . Low in Cost

Sold by Leading Oil Well Supply Dealers

THE TOLEDO PIPE THREADING MACHINE COMPANY
TOLEDO, OHIO NEW YORK OFFICE, 72 LAFAYETTE STREET

"TOLEDO"
TRADE-MARK REGISTERED

THE PERFECTED 1" TO 2" THREADER

"Pistol Pete," Oldest Peace Officer, Maintains Order in New Field

The accompanying photograph is of Frank Eaton, better known as "Pistol Pete", who is supposed to be the oldest

"PISTOL PETE"

peace officer in years of service in the United States. He is now maintaining order in Paradise, a new town in the recently-discovered Ramsey field, Oklahoma.

Program for Western Petroleum Refiners Meeting Announced

The technical program for the 26th annual meeting of the Western Petroleum Refiners Association at Hot Springs, Arkansas, April 25, 26, and 27 has been announced by A. V. Bourque, secretary-treasurer.

The technical sessions, arranged by the manufacturing committee headed by Emby Kaye, vice-president, Skelly Oil Company, will be held Monday afternoon and Tuesday morning. General sessions will be held Tuesday afternoon and Wednesday morning. Tuesday night the regular dinner dance will be held.

Technical discussions will center around new and improved processes of refining and treating, and the results of the Pawhuska road tests conducted last summer, which were sponsored by the Natural Gasoline Association of America and the Western Petroleum Refiners Association. The road tests disclosed inefficiencies in the fuel and carburetion systems of American motor cars that caused gasoline waste, loss of power, and failure to utilize the full value of the gasoline produced by the refiner, Bourque states.

The road tests have created considerable interest among refiners and motor car manufacturers who are reported to be studying future designs to eliminate the waste. Walter Schumann, Cities Service Oil Company engineer, will present the paper on the road tests.

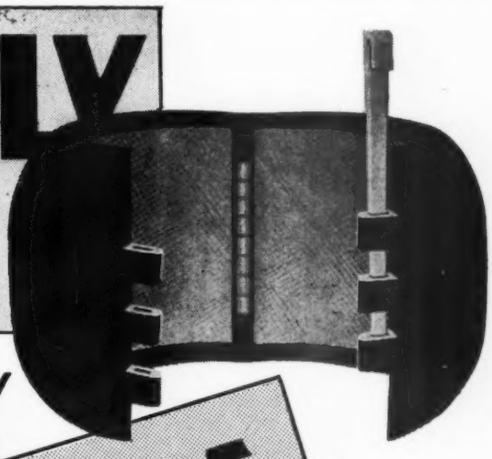
A paper on "True Vapor Phase," a process of cracking in the vapor state, will be presented by a representative of the Alcorn Combustion Corporation. The process has been improved in recent years with some interesting results, according to the company.

The Howard Process, a method of treating gasoline for color stability, sweetness, reduction in sulphur content, and increase in the lead susceptibility will be presented by a representative of the Howard Company.

A fourth paper will be added to the technical program, Bourque said.

Motion pictures will illustrate the methods used at the Pawhuska road tests and other features of the technical program.

GRIZZLY GIANT



Streamlined

DRILL PIPE PROTECTORS

Locks in position with a positive grip that prevents moving from place where installed on pipe . . . yet can be installed or removed in a matter of seconds by one man with a few taps of a hammer.

One-piece rubber body of highest possible resiliency, moulded under tremendous pressure to eliminate expansion strain when installed.

Oil and grease resistant. . . . Can be changed from one string to another and used over and over again.

Provides positive drill pipe protection at all depths, with maximum economy, long life and serviceability.

A BEAR for WEAR

WRITE FOR BULLETIN 9-0F

E. M. SMITH COMPANY

600-650 South Clarence Street, Los Angeles, California, U.S.A.

Complete Stocks Maintained in Our Warehouses At: 2311 West Street, Houston, Texas. 1008 S.E. 29th Street Oklahoma City, Oklahoma. Export Office: Continental Emsco Co., 30 Rockefeller Plaza, New York City Distributed by Leading Supply Companies.

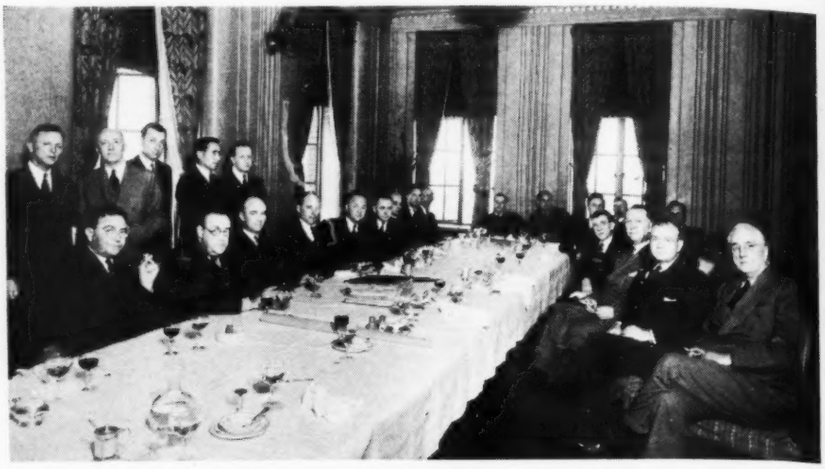
D. C. Royce Resigns from Buckeye

D. C. Royce, who has been affiliated with the Buckeye Traction Ditcher Company, Findlay, Ohio, resigned as general sales manager of the company effective February 15th, and is now in California on a vacation. He expects to spend some time there and may settle permanently in that state.

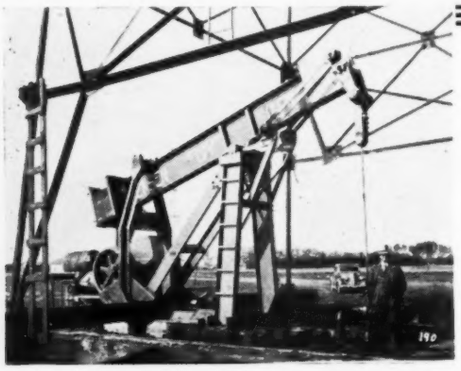
Date Announced for 1939 Houston Oil Show

At a recent meeting of the directors of the Oil-World Exposition the date for the next oil show to be held at Houston, Texas, was set for April 24 to 29, 1939, inclusive. This action is in accordance with the by-laws of the organization and with the desires of the directors to coöperate with the oil industry by not holding the Exposition more frequently than every other year. By unanimous vote the directors appointed Ed G. Lenzner general manager for the '39 Oil-World Exposition.

The 1939 oil show will be increased considerably, it is indicated by the greater demand for space that has been received since the close of the 1937 Exposition. An addition to the main exposition building is being constructed. This will eliminate the necessity for a tent or other auxiliary buildings and will consolidate the indoor spaces to provide added facilities for exhibitors. A very large increase in the outdoor exhibiting space also is being planned to take care of the larger types of equipment and to provide for extensive demonstration work.



The Board of Directors of the Oil-World Exposition met recently at the Houston Club.



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BROTHERS MANUFACTURING CO.

. . . *Coffeyville, Kansas*

YOU CAN LIFT OIL FOR LESS MONEY!

Of course you like the equipment you have or you wouldn't be using it.

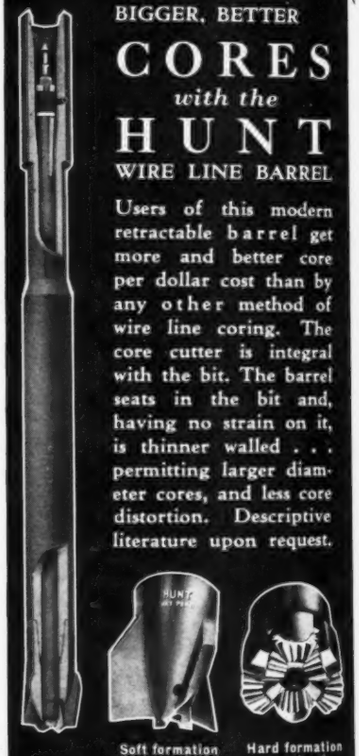
But . . if you knew what a lot of producers know about JENSEN Straight-Lift JACKS you might not be so well satisfied.

For JENSEN JACKS are quietly making history. They're lifting oil for less money and they DON'T keep you in hot water.

Wire Us at COFFEYVILLE

BIGGER, BETTER CORES *with the* HUNT WIRE LINE BARREL

Users of this modern retractable barrel get more and better core per dollar cost than by any other method of wire line coring. The core cutter is integral with the bit. The barrel seats in the bit and, having no strain on it, is thinner walled . . . permitting larger diameter cores, and less core distortion. Descriptive literature upon request.



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Houston, Joinerville, Talco, Corpus Christi, Bay City, Alvin, Texas . . . . Rodessa, Jennings, Houma, Louisiana.

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Enter my subscription for one year. My check in the amount of $2.00 is enclosed.

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New Atlas Supply Store in K. M. A. Field

EXPANSION of the Atlas Supply Company provides a new district office at Wichita Falls and a new store at Electra, Texas.

Harold U. Everett, manager at Fort Worth, is division manager in charge of all Texas operations, and Ralph M.

H. U. EVERETT

R. M. CARTER

Carter is being transferred from the Ada district store to assume district management with headquarters at Wichita Falls. The first new field store is at Electra. Irwin N. Witherspoon, formerly of Vernon and Electra, returns to Electra as manager. The new building is now ready and complete stocks are being carried.

The Wichita Falls office is in the Radio Building.

D. R. Etzel Joins Staff of Baker Oil Tools

D. R. Etzel has been added to the field sales staff of Baker Oil Tools, Inc., Huntington Park, California, his headquarters being at Wichita Falls, Texas.

D. R. ETZEL

Westinghouse Elects George Bucher President

George H. Bucher, executive vice-president of the Westinghouse Electric and Manufacturing Company, has been elected president of the company.

Frank A. Merrick, president since 1929, has been elected vice-chairman. The announcement was made by A. W. Robertson, chairman, following a meeting of the board of directors at the company's New York offices.

Paul Judson Myler, president of the Canadian Westinghouse Company, became a director of the Westinghouse Electric and Manufacturing Company at the same meeting.

Prominent Oil Men Killed in Plane Crash

Dudley S. Golding and A. F. Bowden, both residents of Dallas, Texas,

A. F. BOWDEN

were killed when the airplane in which they were riding struck a power line while making a forced landing eight miles west of Corpus Christi on the night of March 4. The pilot, P. F. (Pop) Hotchkiss, was killed and William Irish, III, vice-president and gen-

DUDLEY S. GOLDING

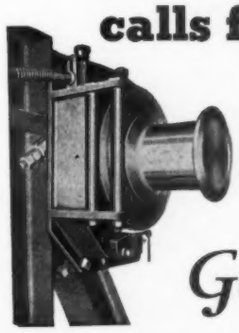
eral manager of the Atlantic Crude Oil Purchasing Company, was injured.

Golding entered the oil business in 1918 in North Texas. In 1926 he formed a partnership with T. B. Cochran and later became associated with C. W. Murchison. At the time of his death he was president of the American Liberty Oil Company and of the American Liberty Pipe Line Company and a partner in the organization of Toddie L. Wynne, trustee.

Bowden maintained an income tax accounting and auditing service, having as associates Roy H. King and Gene Soward, and was vice-president of the Lucey Petroleum Company and a partner in the organization of Toddie L. Wynne, trustee.

MODERN DRILLING

calls for a



Geared

CATHEAD

The high speeds at which many line shafts are being run in today's drilling operations makes it practically imperative that a cathead be geared down to reduce the terrific impact when breaking tool joints. Conventional catheads, when slowed down, lose most of their power, but not the MacClatchie Gearomatic. Due to its patented gear arrangements, it rotates at HALF the line shaft speed yet gives DOUBLE the power.

It breaks the tightest joints with ease and without damage to tongs, tong dies, or other equipment.

A positive kick-out and slow motion insures greater safety. The positive kick-out permits one revolution, and only one, per pull. Consequently, there is no danger of fouled lines injuring workmen or damaging rig equipment when you use the MacClatchie Gearomatic Cathead.

MacCLATCHIE MANUFACTURING CO.

COMPTON, CALIF. HOUSTON, TEXAS

Export:

Geo. R. Woods, 17 Battery Pl., New York

Look! a new RIDGID

Guaranteed Stronger and Safer than Ever!

Here's a tool for you expert pipe wrench users who can't be fooled by shiny metal and ordinary guarantees —the new all-alloy RIDGID with new design stronger housing and I-beam handle that adds still more strength to the famous unconditional guarantee.

It practically stops your pipe wrench repair bother and expense.

With its replaceable no-slip, no-lock chrome molybdenum jaws and unbreakable housing, you've got a wrench you can depend on for any job, in any emergency. Add the pleasure of an adjusting nut that spins freely in all sizes, 6" to 60", a handy pipe scale on the full-floating hook jaw, handle that's comfortable to your hand on a hard pull, and you see why RIDGID is the wrench millions enjoy owning and using.

Buy from your Supply House

THE RIDGE TOOL CO.
ELYRIA, OHIO, U.S.A.

A Work-Saving Tubing Cutter

This remarkable little RIDGID tool smooths the tube for soldering as it cuts it. Integral reamer is handy and efficient. Ask your supply house to show you.

Plan to Register Oil Men Attending Petroleum Exposition Meets With Approval

THE International Petroleum Exposition has grown to be the largest industrial show in the world. Already exhibitors have contracted for 60 percent more space than for the 1936 show and the largest attendance in the history of the event is anticipated. This makes the need for a systematic registration of visitors more urgent than ever before, so that men actively connected with oil and gas companies be readily distinguishable from those on the outside who are prompted to attend out of curiosity only.

The Petroleum Engineer's registration plan provides for the badging of all oil company employees present. The badge will bear the wearer's name and the name of his company. The color of the badge will indicate the division of the industry with which he is identified. A part of the plan entails the giving away of valuable awards to oil men in attendance.

Believing in the need of this type of registration plan 74 exhibiting companies have to date signified their desire to coöperate with *The Petroleum Engineer* in conducting this registration. It is believed that a larger number of additional companies will coöperate.

The following list is comprised of those who already have signified their willingness to participate:

Allis-Chalmers Mfg. Co.
Allsteel Products Mfg. Co.
American Chain & Cable Co.
American Iron & Machine Works
American Steel Derrick Co.
Axelson Mfg. Co.

Baash-Ross Tool Co.
Baker Oil Tools, Inc.
Baroid Sales Co.
Bastian Blessing Co.
Bethlehem Supply Co.
Black, Sivalls & Bryson
Bovaird Supply Co.
Bridgeport Machine Co.
Byron Jackson Co.

Cameron Iron Works
Chapman Valve Mfg. Co.
Chiksan Oil Tools Co.
Continental Supply Co.
Crane Co.

Darling Valve & Mfg. Co.
E. I. duPont de Nemours & Co.
Emsco Derrick & Equip. Co.
Fluid Packed Pump Co.
Franks Mfg. Co.
Frick-Reid Supply Corp.

Gaso Pump & Burner Mfg. Co.
Guiberson Corp.

Hanlon-Waters, Inc.
Hinderliter Tool Co.

International Derrick & Equip. Co.
International Supply Co.

M. O. Johnston Oil Field Service
S. M. Jones Co.

Kerotest Mfg. Co.
Koppers Co.

Lane-Wells Co.
Lucey Products Corp.
Lufkin Foundry & Machine Co.

Maloney Tank Mfg. Co.
Martin-Decker Corp.
Mid-Continent Pump & Supply Co.
Mid-Continent Supply Co.
Mission Mfg. Co.
Lee C. Moore & Co.
Moorlane Co.
Muskogee Iron Works

National Supply Co.
National Tank Co.
W. C. Norris Mfr., Inc.

Oil Country Spec. Mfg. Co.
Oil Well Improvements Co.
Oil Well Supply Co.

Patterson-Ballagh Corp.
Pittsburgh Equitable Meter Co.
Portable Rig Co.

Rector Well Equipment Co.
Reed Roller Bit Co.
Refinery Supply Co.

Seismograph Service Corp.
Shaffer Specialty Co.
Shaffer Tool Works
Skelly Oil Co.
Smith Separator Co.
Sonner Burner Co.

Twin-Disc Clutch Co.

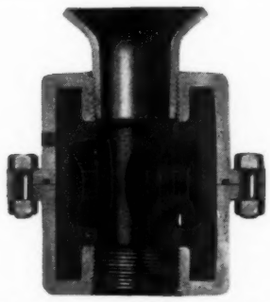
Union Wire Rope Corp.
United Supply & Mfg. Co.

Vortox Mfg. Co.

Walworth Co.
Westcott & Greis
W-K-M Co.
Worthington Pump & Mch. Corp.

Young Engine Corporation

Regan Rod Wiper



The Regan Rod Riper is the 3" Type K blowout preventer body with a special soft rubber of oil resistant stock operable with 45 pounds to 60 pounds air or gas pressure. Rods, couplings and wrench squares are stripped clean by this tool and the plunger may be bumped through and wiped. The clear passage through the wiper is 3" diameter and both ends of the body are tapped for 3" line pipe, with ⅜" standard pipe connections for operating the rubber. Many operations such as water witching, surveying, stratigraphing, paraffin removing while producing, polish rod packing and swabbing, are safely and neatly carried on through this tool.

Ask for Bulletin or Refer to Composite Catalog

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Here...
Oakite Cleaning
RESTORED
Preheater Efficiency

WHEN in a large west coast refinery, preheater temperature dropped 15 degrees, prompt action was called for. The sudden drop followed a gradual lessening of efficiency over several months. Inspection revealed a hard coke-like deposit both outside and inside the tubes.

Under the direction of the near-by Oakite Service Men, the tubes were cleaned with two Oakite materials especially recommended for this kind of work. Results were startling. After the final rinse, *tube surfaces were found to be 100% clean!* A trial run showed a 20-degree rise, indicating heat transfer capacity had been fully restored.

Oakite cleaning experience can help you, too. Tell us your problem. Write. No obligation.

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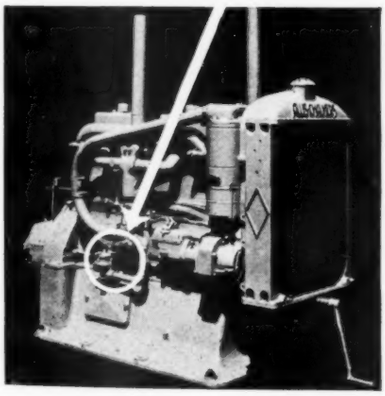
OAKITE *Certified* **CLEANING**
MATERIALS & METHODS FOR EVERY CLEANING REQUIREMENT

LEADING ENGINE BUILDERS CHOOSE **ENSIGN**



ALLIS-CHALMERS
Model E-60 Oil Field Special Power Unit. Arrow points to the ENSIGN Natural Gas Carburetor which is standard equipment.

See Our Exhibit
INTERNATIONAL PETROLEUM EXPOSITION
TULSA
MAY. 14-21

Allis-Chalmers Power Units are synonymous with quality and reliable performance. In the oil industry, these engines are used extensively. ENSIGN *Gas or Combination Gas and Gasoline Carburetors are standard equipment, of course!*

For more than a quarter-century, the ENSIGN Carburetor Company has been occupied exclusively in the design, development and manufacture of precision and quality devices for the efficient and economical carburetion of internal combustion engines.

ENSIGN CARBURETOR CO., LTD.

Can You Spell
"DEPENDABILITY"
in **FIVE LETTERS?**

H-O-U-G-H spells dependability, when it comes to working barrel valves . . . and strict economy, too. It *pays* to specify Hough. For safety's sake, use the Hough "Protex" Upper Valve, illustrated. The Charles N. Hough Mfg. Company, Franklin, Pa., and Tulsa, Okla.

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INTERNATIONAL PETROLEUM EXPOSITION
TULSA
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HOUGH
Working Barrel Valves

There's a

WILLIAMS

SUPERIOR DROP-FORGED TOOLS

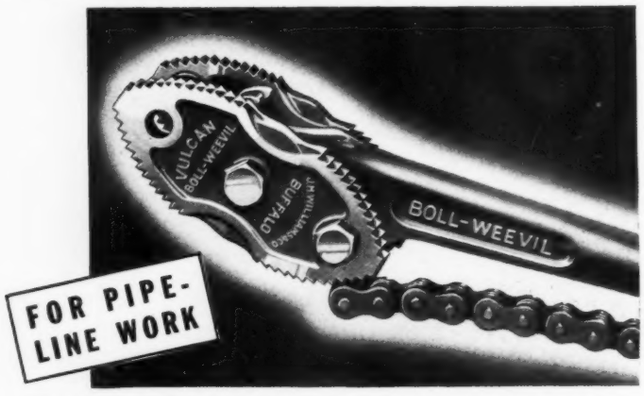
"VULCAN" CHAIN PIPE TONGS

for every

TYPE OF SERVICE!

GENUINE "VULCAN" TONGS: Every part built to bear its share of the load. Chains proof-tested and certified; Jaws and Handle are tough drop-forgings; Through-bolt is extra heavy, and its U. S. Standard Nut simplifies replacement. Nine sizes with either Flat Link or Cable Chain—1/8" to 18" pipe.

Also "VULCAN SUPERTONGS": Same design but drop-forged from Alloy and High Tensile steel, heat-treated and equipped with Alloy "SUPERCHAIN." 50% greater strength than regular "Vulcan" Tongs of corresponding size and weight. Eight sizes for 1/8" to 18" pipe.



"VULCAN BOLL-WEEVIL" TONGS: A reversible action Tong for flat pipe work—very efficient in trenches. Changes instantly from "Making-up" to "Breaking-out" without even unhooking chain. Jaws reversible for double life. Each chain proof-tested and certified. Four sizes, for 3/4" to 12" pipe.

Also "BOLL-WEEVIL-ZEPHYR": Same structural and utility features as regular "Boll-Weevil," but heat-treated and equipped with Alloy "SUPERCHAIN"—stronger and much lighter, capacity for capacity. Three sizes, for 3/4" to 12" pipe.

J. H. WILLIAMS & CO.

261 Spring Street, New York

Headquarters for: Drop-Forged Wrenches (Carbon and Alloy), Detachable Socket Wrenches, Reversible Ratchet Wrenches, "C" Clamps, Lathe Dogs, Tool Holders, Eye Bolts, Hoist Hooks, Thumb Nuts and Screws, Chain Pipe Tongs, Vises, etc.

1-503

Trade Personals

LEON A. WATTS has been appointed to succeed the late SAMUEL MOORE as general superintendent of Allis-Chalmers Manufacturing Company's Service and Erecting Department.

CLAYTON S. COGGESHALL has been made general assistant to R. B. Beale, manager of the turbine division, central station department of the General Electric Company, Schenectady, New York. He formerly was manager of sales of the turbine division, Lynn River works. JOHN L. KERR, previously turbine specialist in the central district, has taken Coggeshall's place at Lynn, and ROBERT S. NEBLETT has become manager of sales, Schenectady section, turbine division.

THEO F. FELDS, for the last five years representing E. D. Bullard Company in its Houston territory, has been promoted to district manager. His new territory includes Texas, Oklahoma, and Louisiana. He will continue to make his headquarters at 1 Main Street, Houston, Texas. E. B. BAIN, an experienced industrial safety man, has been added to the Bullard Houston organization.

ARCH F. CAMPBELL, Tulsa, Oklahoma, Mid-Continent representative for the Waukesha Motor Company, and H. J. LOEBE, service manager, recently made an extended trip through Oklahoma, Kansas, and Texas. Loebe continued on to California where he will visit the various fields.

TRADE LITERATURE

"OILWELL" FLEXIBLE-BLANKET INSULATION is described in Bulletin No. 185, issued by the Oil Well Supply Company, Dallas, Texas. The problem of keeping boiler insulating material in repair while moving a rig from one location to another is said to have been solved by this flexible-blanket insulation because of its ability to withstand hard usage.

THE CHAPLIN-FULTON MANUFACTURING COMPANY, 28-40 Penn Avenue, Pittsburgh, Pennsylvania, has issued its 1938 catalog. In this catalog are illustrated and described the Fulton pressure regulators with automatic cut-off, especially designed for the safe and economical distribution and regulation of natural and manufactured gas, and for the control of steam pressure and gas fuel supply to steam boilers.

THE HYATT BEARINGS DIVISION OF GENERAL MOTORS CORPORATION, Harrison, New Jersey, has issued a pamphlet, illustrating in color and explaining the ten claims it makes for its roller bearings. The claims are reliability, capacity, precision, performance, advanced design, security, protection, economy, range, and quietness.

OFFICIAL DRIVING TESTS, covering a total mileage equivalent to seven-eighths of the distance around the world, in order to test the oil conserving ability of its new flexible Oil Cutter piston ring in competition with other makes are described in a 24-page booklet published by Koppers Company's American Hammered Piston Ring Division, Baltimore, Maryland.

Edgar Greve, of Oil Well Supply Company, Passes Away

Edgar Eugene Greve, formerly chief engineer of Oil Well Supply Company, died March 6 in Dallas following a prolonged illness. He was born in Brooklyn, New York, in 1881, graduated from Stevens Institute of Technology in 1904, and took graduate work at the Colorado School of Mines. Following several years of varied practical and engineering experience in the oil fields, he joined Oil Well Supply Company in 1912 as chief engineer. Although associated with the company until the time of his death, he discontinued active duty in 1935 in an effort to overcome a lung affliction, which, however, did not yield to treatment. He accordingly retired under the company's benefit plan in 1937.

EDGAR E. GREVE

Greve's name has been associated with many improvements and developments in oil field equipment of the past 25 years. He maintained an active interest in the A.S.M.E., the A.S.T.M., and the American Petroleum Institute, and served on committees of the Division of Production of the A.P.I. He also participated in the affairs of various technical societies.

Book Reviews

Erdölbestandteile Bisher Aus Erdölen Isolierte Chemische Individuen, by Dr. Edmund Waldmann, Österreichisches Petroleum-Institut, Wien, I., Eschenbachgasse 9, Austria. 1937. 67 pp. Price $4.00.

The Austrian Petroleum Institute has arranged in tabular form the chemical compounds identified in petroleum prior to 1937, together with the structural formulae, physical constants, the sources of the material in which the compounds are found, and references to the original literature. The work is divided into two parts, the first including compounds derived from natural oil and the second including the products derived from cracked oil. The compounds are grouped in their natural classifications, as paraffins, naphthenes, etc., and are arranged in order of increasing carbon content.

* * *

Carbon Dioxide in New Mexico, by E. H. Wells and A. Andreas, New Mexico School of Mines "Gold Pan" Supplement No. 1, Socorro, New Mexico, Jan. 31, 1938. 8 pp.

This pamphlet describes the properties and uses of carbon dioxide, and also of the solid form, "Dry-ice." The theories concerning its origin underground, description of the geologic structures in which it has been found in New Mexico, and the name and capacity of each plant built for converting it into "Dry-ice" are also included. Problems in manufacture, transportation, and distribution of "Dry-ice" are discussed.

Have you ever tried a

B-M-W Admore Liner Barrel?

This inexpensive unit is used wherever oil is produced from pumping wells. An inverted type insert pump. Here we show one equipped with an 8-Cup Plunger. The ADMORE Pump may also be fitted with a combination Cup-and-Packing Plunger, and gives amazing results with the TEX TYPE Plunger.

Made for 2", 2½" and 3" Tubing, and in lengths to handle any desired stroke. The pump is seated in the top of a common working barrel or in a special seating nipple in the tubing. It may also be seated with a mechanical seating device which requires no cups. And it can be used to pump from any level in the tubing when used in connection with the B-M-W ADMORE INSERT PUMP ANCHOR.

Installed without the necessity of pulling tubing. Used successfully in wells as deep as 6,000 feet. In the deeper wells the sucker rod load is much less than when standard size cups or plungers are used, while the loss in capacity is negligible due to more effective plunger stroke.

B-M-W PRODUCTS ARE OBTAINABLE

at supply stores, including the above described ●ADMORE Liner Barrels; ●ADMORE Insert Pump Anchors; ●NEILSON TOOLS (Safety Sucker Rod Hooks, Tubing Hooks, Rod Elevators, Sucker Rod Sockets, etc.); ●BALLS and SEATS (made for every pumping service); ●TEX TYPE Plunger Fittings and Valves; and ●COLLINS Belt Clamps.

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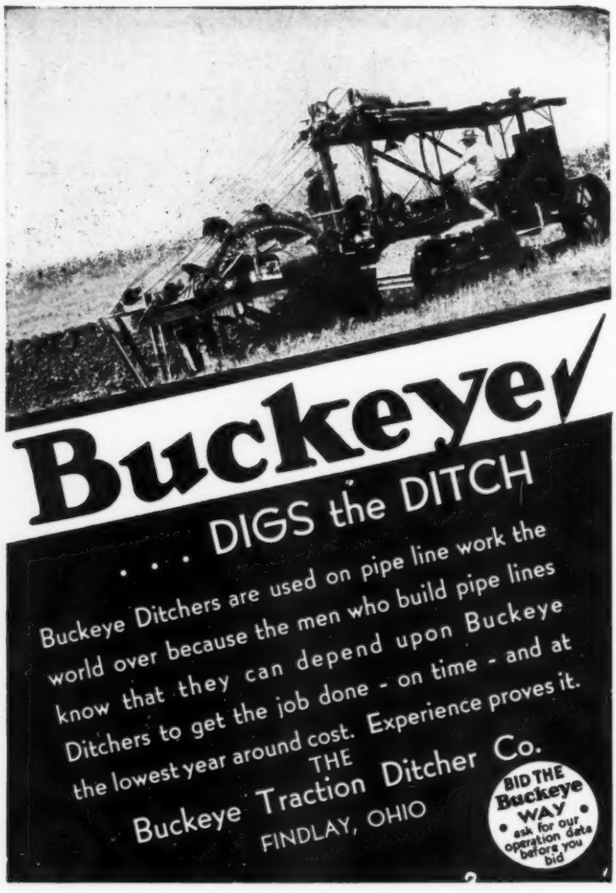
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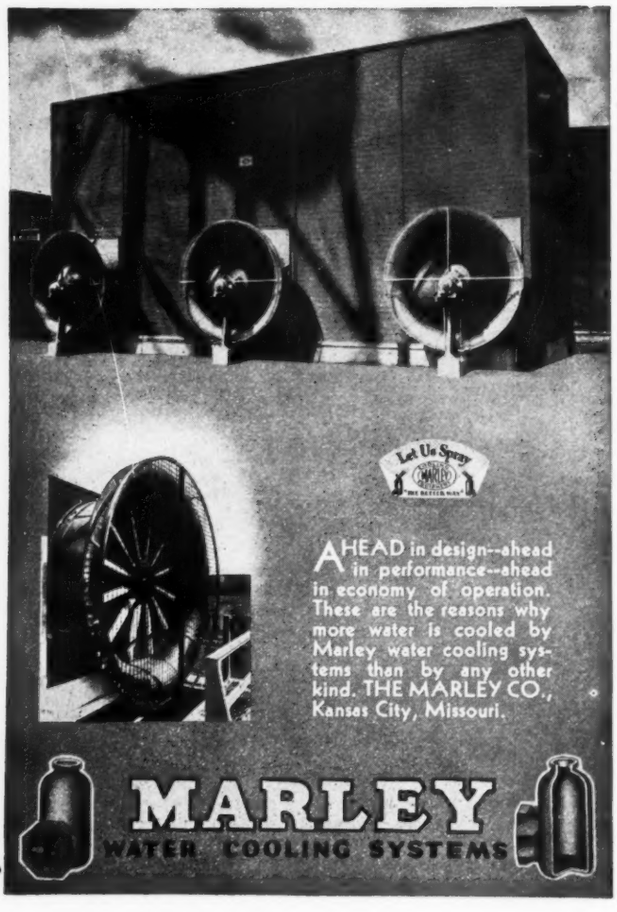
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Allis-Chalmers Organization Changes

Allis-Chalmers Manufacturing Company's Publicity Department for power, electrical, and industrial machinery now has two divisions. George Callos has been appointed assistant manager in charge of sales promotion, embracing advertising, bulletins, exhibitions, house organs, etc. A. K. Birch has been appointed assistant manager in charge of market analysis, sales organization service embracing price books, data and sales information, and the distribution of literature.

Lewis M. Parsons Promoted by Jones and Laughlin

LEWIS M. PARSONS

Lewis M. Parsons has been elected vice-president in charge of sales and a director of the Jones and Laughlin Steel Corporation, Pittsburgh, Pennsylvania.

Leaving the University of Pennsylvania in 1917 Parsons joined the Navy and served in the World War in the destroyer service and later in the Naval Flying Corps. Upon being discharged at the end of the war he entered the employ of the Bethlehem Steel Company in the sales division. He was made assistant manager of sales, Philadelphia office, in 1932, and manager of sales at the same office in 1936.

With Jones and Laughlin, effective March 1st, he has charge of all sales activities, including district sales offices in the following cities: Atlanta, Boston, Buffalo, Chicago, Cincinnati, Cleveland, Dallas, Denver, Detroit, Houston, Los Angeles, Memphis, Milwaukee, Minneapolis, New Orleans, New York, Philadelphia, Pittsburgh, St. Louis, San Francisco, Seattle, Tulsa, and Toronto, Canada; and warehouses at Chicago, Cincinnati, Detroit, Memphis, New Orleans, New York, and Pittsburgh.

Ross Brewer Appointed District Manager By Continental Supply

ROSS BREWER

Appointment of Ross Brewer as district manager of the West Texas and New Mexico district of the Continental Supply Company has been announced from the company's home office in Dallas, Texas.

Brewer, whose entry into the supply business was with Continental in Oklahoma in 1919, has a wide acquaintance among Mid-Continent oil men. He has served as assistant district manager since 1930, and will continue to make his headquarters in Fort Worth, Texas.

Southwestern District A.P.I. Meeting

The program for the meeting of the Southwestern District, Division of Production, American Petroleum Institute, to be held at the Blackstone Hotel, Fort Worth, Texas, March 24 and 25, has been announced as follows:

THURSDAY, MARCH 24, 1938

8:00 a. m. Breakfast meeting for officers of Southwestern District, presiding officers, and authors. Dining Room A, Blackstone Hotel.

9:00 a. m. Registration, Mezzanine Floor.

Registration headquarters will be open on the Mezzanine Floor, Blackstone Hotel, at 3 p. m., March 23, 1938. A registration fee of $1.50 will be charged each registrant, to cover incidental costs of meeting and advance copies of papers. A complete report of all discussions, including reports of other district meetings, will be sent to each registrant.

10:00 a. m. Morning Session, Main Ballroom, Mezzanine Floor, Blackstone Hotel. Presiding: W. E. Schoeneck, The Ohio Oil Company, Shreveport, Louisiana. Associate chairmen: L. A. Ogden, The Pure Oil Company, Fort Worth, Texas; H. M. Staggs, The Atlantic Refining Company, Dallas, Texas.

1. Address of Welcome, Amon G. Carter, Fort Worth. Response, A. G. Levy (Crown Central Petroleum Corporation, Houston, Texas), district chairman.
2. "Progress in Oil Industry Vocational Training in Texas," J. R. D. Eddy, Texas State Board for Vocational Education, Austin, Texas.
3. "Individual Training in Accident Prevention," A. W. Breeland, Lone Star Gas Company, Dallas, Texas.
4. Announcements.

2:00 p. m. General Session, Main Ballroom, Mezzanine Floor, Blackstone Hotel. Presiding: A. G. Levy, Crown Central Petroleum Corporation, Houston, Texas.

1. "Administration of the Oil Industry in New Mexico," Hon. H. M. Dow, lieutenant-governor, State of New Mexico, Roswell, New Mexico.
2. "What the Oil Industry Means to the Southwest," W. R. Boyd, Jr., executive vice-president, American Petroleum Institute, New York City.
3. "The Growth and Importance of Natural Gas in the Southwest," John S. Ivy, vice-president, Union Producing Company, Houston, Texas.
4. Announcements.

7:30 p. m. Stag Smoker—Shady Oaks Lodge on Lake Worth.
(Guests of Amon G. Carter)
All registrants are invited to attend.

FRIDAY, MARCH 25, 1938

8:00 a. m. Breakfast meeting for officers of Southwestern District, presiding officers, nominating committee, and authors—Dining Room A, Blackstone Hotel.

9:30 a. m. Morning Session—Main Ballroom, Mezzanine Floor, Blackstone Hotel. Presiding: W. S. Morris, East Texas Engineering Association, Kilgore, Texas. Associate chairmen: C. E. Reistle, Jr., Humble Oil and Refining Company, Houston, Texas; H. H. Hardison, Standard Oil Company of Texas, Midland, Texas.

1. "Well Treatment After Perforating," Bruce Barkis, Lane-Wells Company, Los Angeles, California.
2. "Pressure Production Relationship—East Texas Field," S. E. Buckley, Humble Oil and Refining Company, Houston, Texas.
3. "Problems in Design of a Salt Water Gathering System," J. E. Bailey, Tide Water Associated Oil Company, Kilgore, Texas.
4. Election of district officers and advisory committee. Report of nominating committee.
5. Announcements.

2:00 p. m. Afternoon Session—Main Ballroom, Mezzanine Floor, Blackstone Hotel. Presiding: E. A. Wahlstrom, Goldsmith Pool Engineering Committee, Midland, Texas. Associate chairmen: C. G. Staley, Lea County proration office, Hobbs, New Mexico; W. A. Alexander, Shell Petroleum Corporation, Iowa, Louisiana.

1. "The Permian Basin and Its Drilling and Production Problems," W. T. Doherty, Humble Oil and Refining Company, Midland, Texas.
2. "The Use of Drilling Time in Determining Completion Practices—Goldsmith Pool," Max David, Landreth Production Corporation, Midland, Texas.
3. "Marine Drilling on the Gulf Coast," I. W. Alcorn, The Pure Oil Company, Houston, Texas.
4. Announcements.

7:30 p. m. Informal dinner dance—Fort Worth Club. Tickets, $3 each.

SPECIAL NOTICE TO VISITING LADIES

A luncheon style show will be held in the Fort Worth Club on Thursday, March 24, at 12:30 p. m. Complimentary tickets will be supplied on request to Mr. Kelly.

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INDEX *to* ADVERTISERS

Abercrombie, J. S. Company 89
Allis-Chalmers Mfg. Co.
American Cable Division of American Chain & Cable Co., Inc
American Chain & Cable Company, Inc. Inside Back Cover
American Hammered Piston Ring Div. 4
American Iron and Machine Works Co.
American Lubricator Co. 92
American Meter Co. 126
American Roller Bearing Company 19
American Rolling Mill Co. 15
American Steel & Wire Co.
Armstrong Bros. Tool Co. 10
Axelson Manufacturing Co. 91

Baash-Ross Tool Co.
Baker Oil Tools, Inc. 118
Baroid Sales Co. 11
Bartlett-Hayward Division 81
Beaver Pipe Tools 97
Bethlehem Steel Co.
Black, Sivalls & Bryson, Inc. 120
Bradford Motor Works, Inc. 109
Bridgeport Machine Company
Broderick & Bascom Rope Co.
Buckeye Traction Ditcher Co. 110
Byron Jackson Co. 7

Cameron Iron Works
Cavins Co., The 101
Chaplin-Fulton Mfg. Co., The 111
Chapman Valve Mfg. Co., The 63
Chiksan Oil Tools Co., Ltd. 95
Clark Bros. Co.
Cleveland Trencher Co., The 10
Climax Molybdenum Co. 128
Continental Supply Co., The 53
Cook, C. Lee, Mfg. Co. 94
Cooper-Bessemer Corp., The 45
Cummins Engine Co. 5

Dowell, Incorporated 23
Dresser, S. R., Mfg. Co.
Durametallic Corp.

Elliott Core Drilling Co. 8
Emsco Derrick & Equip. Co.
Ensign Carburetor Co., Ltd. 107

Franks Mfg. Co.
Frick-Reid Supply Corporation

Gaso Pump & Burner Mfg. Co. 2
General Electric Co.
Gott, H. P., Mfg. Co. 111
Grant Oil Tools Company
Gray Tool Company
Guiberson Corporation 56

Halliburton Oil Well Cementing Company Back Cover
Hazard Wire Rope Division of American Chain & Cable Co., Inc. Inside Back Cover
Hough, Chas. N., Mfg. Co. 107
Houston Lighting & Power Co.
Hughes Tool Company 73
Hunt Tool Co. 104
Hyatt Roller Bearing Co.

International Derrick & Equipment Company
International Geophysics, Inc.
International Harvester Company
International Petroleum Exposition 79
International Supply Company 12

Jarecki Mfg. Company
Jensen Bros. Mfg. Co. 104
Johns-Manville
Johnston, M. O. Oil Field Service Corporation 13
Jones & Laughlin Steel Corp.
Jones, S. M., Co.

Kerotest Manufacturing Co.
Kobe, Incorporated 77
Koppers Company 4 and 81
American Hammered Piston Ring Division, Bartlett Hayward Division, Engineering and Construction Division, Tar and Chemical Division, Western Gas Division, Wood Preserving Corp., The.

Lane-Wells Co. 60-61
Layne & Bowler Company
Leschen, A., & Sons Rope Co. 16
Linde Air Products Co., The
Link-Belt Company 25
Lone Star Cement Corp. 51
Lufkin Foundry & Machine Co. 47
Lunkenheimer Co., The 122

MacClatchie Mfg. Co. 105
Macwhyte Company 3
Marley Co. 110
Martin-Decker Corp. 100
Mepham, Geo. S., Corp. 75
Merco Nordstrom Valve Co.
Merla Tool Company 98
Metric Metal Works 126
Midco Bailer Co.
Miller Sand Pump Co. 112
Mission Mfg. Co. 124
Moore, Lee C., & Co. Front Cover

National Supply Companies, The 71
National Tube Co.

Oakite Products, Inc. 107
Oil Country Specialties Mfg. Co. 6
Oil Center Tool Co.
Oil Well Supply Co. 59
Otis Pressure Control, Inc.
Oxwell Acetylene Co.

Parkersburg Rig & Reel Co. 87
Patterson-Ballagh Corporation 9
Penberthy Injector Co. 21
Petroleum Electric Power Club 83
Petroleum Rectifying Co. 29
Pittsburgh Equitable Meter Co.
Prest-O-Lite Company, Inc., The

Rector Well Equipment Co. 93
Reda Pump Company 55
Reed Roller Bit Company 32 and 116
Regan Forge & Engineering Co. 107
Ridge Tool Co. 106

Schlumberger Well Surveying Co.
Sealed Power Corp.
Seismic Explorations, Inc. 31
Shaffer Tool Works 1
Shull Perforating Co. 109
Smith, A. O., Corp. 68-69
Smith, E. M., Company 103
South Chester Tube Co.
Spang & Company 96
Sperry-Sun Well Surveying Co. 99
Taylor Instrument Companies
Thornhill-Craver Co.
Toledo Pipe Threading Machine Company 102
Tretolite Company Inside Front Cover
Trimont Manufacturing Co.
Trinity Portland Cement Co.
Twin Disc Clutch Company

Union Carbide & Carbon Corp.
Union Carbide Sales Co.
Union Wire Rope Corporation 85
U. S. Steel Corporation Subsidiaries 59
Universal Atlas Cement Co.

Waukesha Motor Co.
Williams, J. H., & Co. 108
W-K-M Company, Inc. 65
Worthington Pump & Machinery Corp., Carbondale Div.
Youngstown Sheet & Tube Co. 27

THE *Petroleum* Engineer's CONTINUOUS TABLES

A DAILY REFERENCE FOR OPERATING MEN

INSTALLMENT NO. 10

INDEX TO TABLES*

(This index supersedes the index in the February issue)

Title of Table		*Index No.*	*Page*	*Issue*
Decimal equivalents of common fractions		P 061.000	161	February
Pressure conversion table		P 066.	135	June
Characteristics of oil industry wire rope		P 094.13	167	October
Belt speed	(sheet 1)	P 094.603.1	133	January
Piston displacement and rated horsepower for 4-cylinder motors		P 094.843.4	259	August
Piston displacement and rated horsepower for 6-cylinder motors		P 094.843.6	161	October
Displacement of reciprocating pumps	(sheet 1)	P 094.865	123	July
Displacement of reciprocating pumps	(sheet 2)	P 094.865	125	July
Density of gas specific gravity 0.6 relative to air = 1		P 213.106	229	September
Multipliers for converting measured volume to volume at 60° fahr.	(sheet 1)	P 213.2	147	December
Multipliers for converting measured volume to volume at 60° fahr.	(sheet 2)	P 213.2	121	March
Viscosity conversion factors		P 216.13[b]	137	June
Specific heat of liquid petroleum		P 235.5	135	January
Drainage by uniformly spaced wells		P 412.	253	August
Cross-sectional area of drainage channels into well bore		P 420.4	157	October
Concrete corner foundations for drilling derricks		P 421.3	169	October
Capacity of large A.P.I. sand reel, narrow drum		P 422.143.151	127	January
Heat loss from uninsulated 2-in. steam lines		P 422.335	127	July
Maximum safe working load on drilling and casing lines		P 422.913	233	September
Horizontal and vertical displacement of crooked holes		P 425.2	129	June
Dimensional comparison of tool joints		P 425.223.2	115	March
Weight of drill pipe and casing and volume of fluid displaced		P 425.24	121	July
Weight and displacement of 2⅞-in. drill pipe		P 425.240.287	123	March
Hydrostatic pressure of fluid columns of different densities		P 425.25	125	June
Cross-section area of annular space between drill pipe and casing		P 425.251.12	149	December
Clearance between drill pipe and casing	(sheet 1)	P 425.294.39	159	November
Clearance between drill pipe and casing	(sheet 2)	P 425.294.39	145	December
Strength of casing		P 432.2	257	August
Strength of light weight surface casing		P 432.200.1	123	January
Net weight of casing floated in fluid	(sheet 1)	P 435.	147	November
Net weight of casing floated in fluid	(sheet 2)	P 435.	131	January
Cross-sectional area of space between casing and wall of well		P 439.432.2	117	March
Clearance between casing strings	(sheet 1)	P 439.439	169	February
Amount of cement necessary to form plug about casing in well		P 444.	117	July
Total upward pressure between drill pipe and casing	(sheet 1)	P 448.425	151	December
Hydrostatic pressure of fluid columns		P 510.021.31	157	February
Maximum safe pumping depth for wooden walking beams		P 514.350.20	163	October
Weight of fluid on plunger in pumping wells		P 514.5	109	July
Oil reserves, bbl. per acre foot		P 530.1	155	November
Theoretical displacement of oil well plunger pumps	(sheet 1)	P 531.[a]	119	July
Theoretical displacement of oil well plunger pumps	(sheet 2)	P 531.	263	August
Theoretical displacement of oil well plunger pumps	(sheet 3)	P 531.	227	September
Weight of plain tubing, empty and full of fluid		P 532.400.1	127	March
Weight of external upset tubing, empty and full of fluid		P 532.400.2	225	September
Maximum safe working load on tubing and rod lines		P 532.7	255	August
Velocity of flow through 2½-in. tubing		P 533.300.25	119	March
Pressure of input water at sand face, lb. per sq. in.	(sheet 1)	P 538.066	165	February
Barrels of flood water required per acre		P 538.2	113	July
Capacity of small vertical cylindrical tanks		P 541.1	143	December
Storage capacity of gas sands		P 543.6	133	June
Pressure drop per mile of 4-in. pipe line, oil of 20° A.P.I.		P 615.104.20	165	October
Pressure drop per mile of 4-in. pipe line, oil of 40° A.P.I.		P 615.104.40	231	September
Pressure drop per mile of 6-in. pipe line, oil of 20° A.P.I.		P 615.106.20	235	September
Pressure drop per mile of 6-in. pipe line, oil of 40° A.P.I.		P 615.106.40	115	July
Pressure drop per mile of 8-in. pipe line, oil of 20° A.P.I.		P 615.108.20	125	January
Pressure drop per mile of 8-in. pipe line, oil of 40° A.P.I.		P 615.108.40	261	August
Pressure drop per mile of 10-in. pipe line, oil of 20° A.P.I.		P 615.110.20	167	February
Pressure drop per mile of 10-in. pipe line, oil of 40° A.P.I.		P 615.110.40	139	December
Capacity of bolted tanks	(sheet 1)	P 644.200.1	153	November

INDEX TO TABLES—(Continued)

A.P.I. dimensional specifications for bolted tanks	P 644.210	151	November
Storage capacity of pipe lines	P 649.	131	June
Corrosion in refineries	P 706	159	February
Density and acid content of sulphuric acid solutions	P 725.116.4	125	March
Specific gravity of caustic soda solutions	P 725.213.2	163	February
Density and caustic content of caustic soda solutions	P 725.216.4	223	September
Yields on cracking light and heavy oils	P 751.01	111	July
Yield of cracked gasoline	P 751.234.2	149	November
Viscosity index of oil	P 753.016.101	129	July
Gravity index of oil	P 753.016.102	141	December
Viscosity-gravity constant of oil	P 753.016.103	159	October
Properties of constituents of natural gasoline	P 771.2	129	January
Vapor pressure of the lighter hydrocarbons	P 771.214.2	265	August
Correction to convert uncorrected vapor pressure to Reid vapor pressure	P 778.2	127	June
Pressure required to prevent storage evaporation losses	P 778.3	157	November

*This index is revised monthly as additional tables are published.
(a) In footnote, "feet" should read "inches."
(b) Headings "Redwood No. 1 seconds" and "Redwood admiralty seconds" should be transposed.

INDEX TO ADVERTISERS IN TABLES

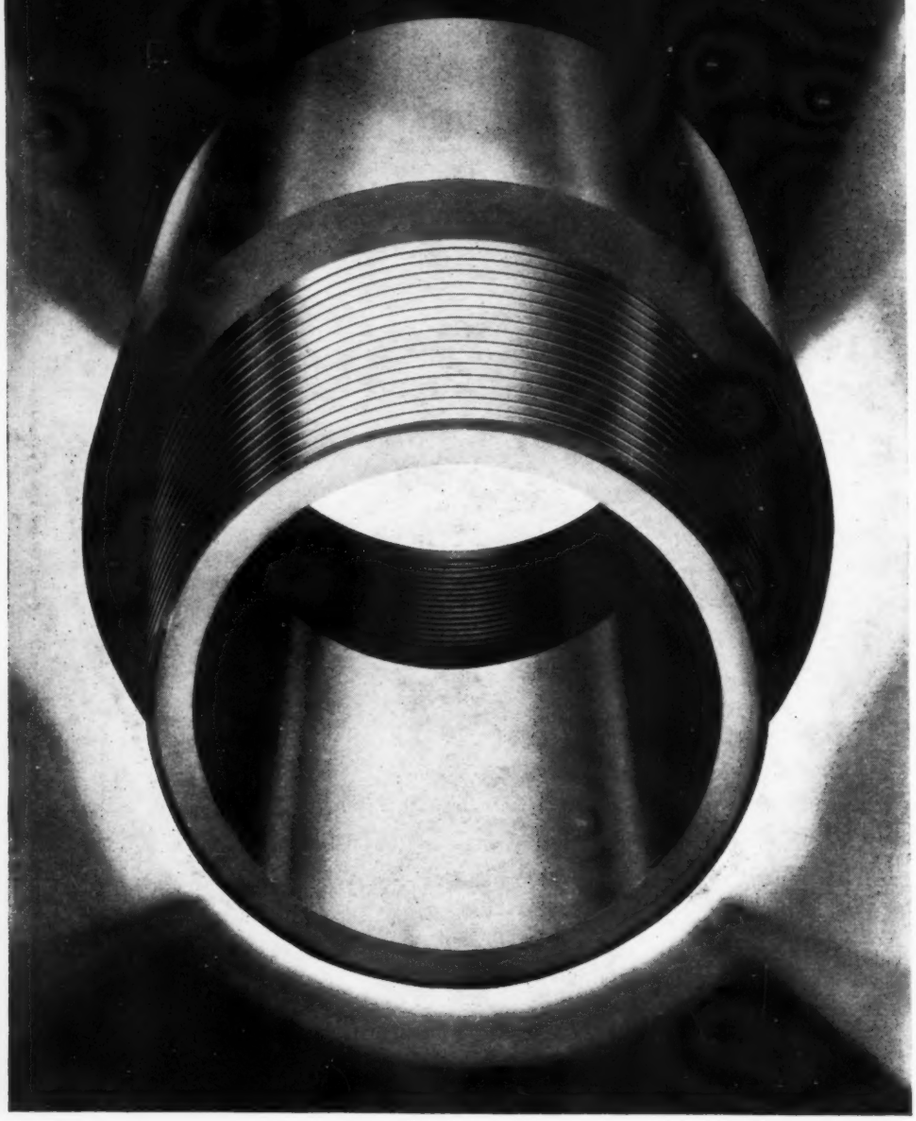
	Page	*Issue*	*Backing Table No.*
American Iron & Machine Works	254	August	P 412.
American Meter Company	130	July	P 753.016.101
American Meter Company	130	January	P 771.2
American Meter Company	126	March	P 752.116.4
American Rolling Mill Company	124	January	P 432.200.01
American Rolling Mill Company	168	February	P 615.110.20
Axelson Manufacturing Company (sheet 1)	120	July	P 531.
Axelson Manufacturing Company (sheet 3)	228	September	P 531.
Baker Oil Tools, Inc.	158	October	P 420.4
Baker Oil Tools, Inc. (sheet 1)	148	November	P 435.
Baker Oil Tools, Inc.	118	March	P 439.432.2
Black, Sivalls & Bryson, Inc.	120	March	P 533.300.25
Broderick & Bascom Rope Company	128	January	P 422.143.151
Brown Instrument Company	230	September	P 213.106
Byron Jackson Company	114	July	P 538.2
Cameron Iron Works, Inc.	126	June	P 425.25
Climax Molybdenum Company	160	February	P 706.
Climax Molybdenum Company	128	March	P 532.400.1
Cooper, Fred E.	256	August	P 532.7
Eastman Oil Well Survey Company	130	June	P 425.2
Elliott Core Drilling Company	134	June	P 543.6
Elliott Core Drilling Company (sheet 2)	132	January	P 435.
Gaso Pump and Burner Mfg. Co. (sheet 1)	124	July	P 094.865
Gaso Pump and Burner Mfg. Co. (sheet 2)	126	July	P 094.965
Gaso Pump and Burner Mfg. Co.	140	December	P 615.110.40
Gasoline Products Company, Inc.	112	July	P 751.01
General Electric Company	138	June	P 216.13
Gray Processes Corporation	224	September	P 725.216.4
Gustin-Bacon Mfg. Company	236	September	P 615.106.20
Gustin-Bacon Mfg. Company	134	January	P 094.603.1
Hyatt Roller Bearing Company (sheet 2)	148	December	P 213.2
Hyatt Roller Bearing Company	162	February	P 061.000
International Derrick & Equipment Company	170	October	P 421.3
International Harvester Company (sheet 2)	264	August	P 531.
Johnston, M. O., Oil Field Service Corp.	122	July	P 425.24
Jones & Laughlin Steel Corp.	232	September	P 615.104.40
Kibele Manufacturing Company	226	September	P 532.400.2
Layne & Bowler Company	144	December	P 541.1
Layne & Bowler Company (sheet 1)	166	February	P 534.066
Linde Air Products Company, The	132	June	P 649.
Linde Air Products Company, The	126	January	P 615.108.20
Lunkenheimer Company, The (sheet 2)	122	March	P 213.2
Maloney Tank Mfg. Company (sheet 1)	154	November	P 644.200.1
Martin-Decker Corp.	128	July	P 422.335
Mason-Neilan Regulator Company	136	June	P 066.
Mason-Neilan Regulator Company	226	August	P 771.214.2
Mason-Neilan Regulator Company	158	November	P 778.3
Mid-Continent Pump Supply Company	164	October	P 514.350.20
Mission Manufacturing Company	110	July	P 514.5
Mission Manufacturing Company	158	February	P 510.021.31
Mission Manufacturing Company	124	March	P 425.240.287
National Tube Company	152	November	P 644.210
O. C. S. Manufacturing Company	156	November	P 530.1
Patterson-Ballagh Corporation (sheet 1)	160	November	P 425.294.39
Patterson-Ballagh Corporation (sheet 2)	146	December	P 425.294.39
Petroleum Rectifying Company	136	January	P 235.5
Polymerization Process Corporation	150	November	P 751.234.2
Reed Roller Bit Company	258	August	P 432.2
Reed Roller Bit Company	116	March	P 425.223.2
Ridge Tool Company	116	July	P 615.106.40
Skinner, M. B., Company	262	August	P 615.108.40
South Chester Tube Company	166	October	P 615.104.20
South Chester Tube Company	150	December	P 425.251.12
South Chester Tube Company (sheet 1)	170	February	P 439.439
Staynew Filter Corporation	128	June	P 778.2
Taylor Instrument Company	142	December	P 753.016.102
Taylor Instrument Company	164	February	P 725.213.2
Trinity Portland Cement Company	118	July	P 444.
Trinity Portland Cement Company (sheet 1)	152	December	P 448.425
Union Wire Rope Corporation	168	October	P 094.13
Vortox Manufacturing Company	260	August	P 094.843.4
Vortox Manufacturing Company	162	October	P 094.843.6
Westinghouse Electric & Manufacturing Company	160	October	P 753.016.103
Williamsport Wire Rope Company	234	September	P 422.913

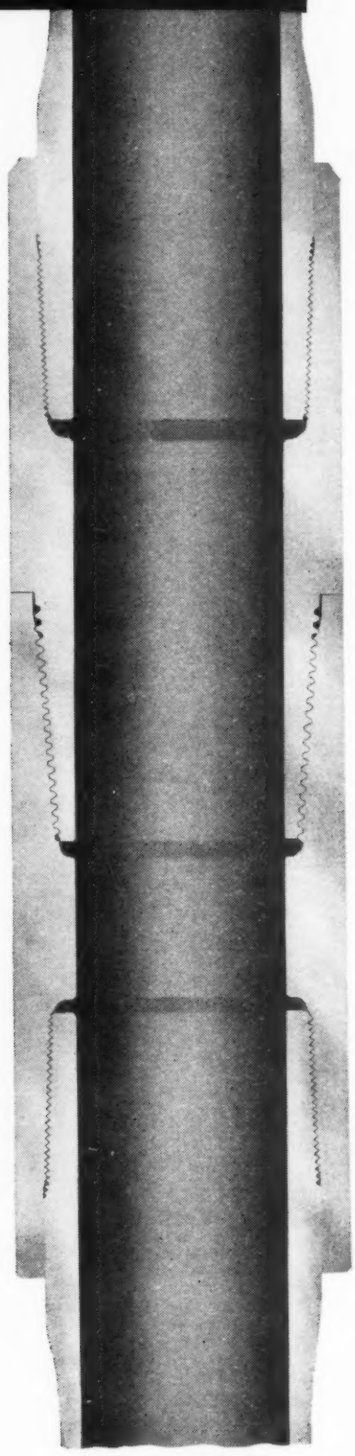
DIMENSIONAL COMPARISON OF A.P.I. REGULAR AND A.P.I. FULL HOLE TOOL JOINTS WITH INTERNAL FLUSH TOOL JOINT

Size of tool joint, in.	Type of tool joint	Drill pipe size, in.		Pitch diameter, in.	No. of threads per in.	Taper, in. per ft.	Outside diameter of tool joints, in.		Bore of tool joint, in.	Area of tool joint in pin-end, sq. in.	Length, in.	Comparison of openings
		Internal upset	External upset				Standard	Optional				
2 3/8	Internal flush	.....	2 3/8	2.668	4	2	3 3/8	.....	1 3/4	2.4	16	308%
2 3/8	Full hole	2 3/8	.....	2.5216	5	3	3 3/8	.....	1 7/16	1.6	16	205%
2 3/8	A. P. I. regular	2 3/8	.....	2.3653	5	3	3 1/8	.....	1	.78	16	100%
2 7/8	Internal flush	.....	2 7/8	3.1824	4	2	4 1/8	.....	2 1/8	3.54	17	295%
2 7/8	Full hole	2 7/8	.....	3.0842	5	3	4	.....	1 7/8	2.8	17	233%
2 7/8	A. P. I. regular	2 7/8	.....	2.7403	5	3	3 3/4	.....	1 1/4	1.2	17	100%
2 7/8	A. P. I. full hole	.....	2 7/8	3.3653	5	3	4 1/4	.....	2 1/8	3.54	17	.....
3 1/2	Internal flush	.....	3 1/2	3.808	4	2	4 3/4	.....	2 11/16	5.67	18	334%
3 1/2	A. P. I. full hole	3 1/2	.....	3.7340	5	3	4 5/8	.....	2 7/16	4.70	18	276%
3 1/2	A. P. I. regular	3 1/2	.....	3.2398	5	3	4 1/4	4 1/2	1 1/2	1.70	18	100%
4 1/2	Internal flush	.....	4 1/2	5.0417	4	2	6 1/8	.....	3 3/4	11.04	20	283%
4 1/2	A. P. I. full hole	4 1/2	3 7/8	4.5320	5	3	5 3/4	.....	*3 5/32	7.8	20	200%
4 1/2	A. P. I. regular	4 1/2	.....	4.3648	5	3	5 1/2	5 3/4	2 1/4	3.9	20	100%
5 9/16	Internal flush	.....	5 9/16	6.189	4	2	7 3/8	.....	4 13/16	18.19	22	308%
5 9/16	A. P. I. full hole	5 9/16	4 3/4	5.5910	4	2	7	6 3/4	4	12.6	22	222%
5 9/16	A. P. I. regular	5 9/16	.....	5.2340	4	3	6 3/4	.....	2 3/4	5.9	22	100%
6 5/8	Internal flush	.....	6 5/8	7.251	4	2	8 1/2	.....	5 29/32	27.38	24	285%
6 5/8	A. P. I. full hole	6 5/8	5 3/4	6.5196	4	2	8	7 3/4	5	19.6	24	204%
6 5/8	A. P. I. regular	6 5/8	.....	5.7578	4	2	7 3/4	.....	3 1/2	9.6	24	100%

*3 in. when tool joints used on 16.60 lb. drill pipe.

SPECIFY
REED TOOL JOINTS





Choice of

A.P.I. REGULAR — A.P.I. FULL HOLE

WELDED — SHRINK WELD

EXTERNAL FLUSH — INTERNAL FLUSH

DOUBLE GRIP — SHRINK GRIP

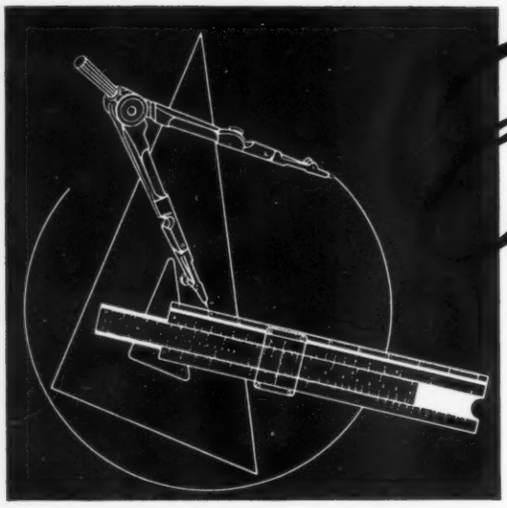
The REED
INTERNAL FLUSH SHRINK GRIP
TOOL JOINT
FOR
REDUCED DRILLING COSTS

REED ROLLER BIT CO.

CROSS-SECTIONAL AREA, SQ. IN., OF ANNULAR SPACE BETWEEN CASING AND WALL OF WELL

Diameter of drill hole, in.[1]	Diameter of casing, O. D., in.																							
	4¾	5	5½	5¾	6	6⅝	7	7⅝	8	8⅛	8⅝	9	9⅝	10	10¾	11¾	12	13	13⅜	14	16	18⅝	20	21½	24½
6	11	9																							
6½	16	14	9																						
7	21	19	15	12	10																				
7½	26	25	20	18	16	10																			
8	33	31	26	24	22	16	12																		
8½	39	37	33	31	28	22	18																		
9	46	44	40	38	35	29	25	18	13																
9½	53	51	47	45	43	36	32	25	21	19															
10	61	59	55	52	50	44	40	33	28	27	20														
10½	69	67	63	61	58	52	48	41	36	35	28	23													
11	77	75	71	69	67	60	56	49	45	43	37	31	22												
11½	86	84	80	78	76	69	65	58	54	52	46	40	31	25											
12	95	94	89	87	85	79	75	67	63	61	55	50	40	35	22										
12½	105	103	99	97	94	88	84	77	72	71	64	59	50	44	32										
13	115	113	109	107	104	98	94	87	82	81	74	69	60	54	42	24									
13½	125	124	119	117	115	109	105	97	93	91	85	80	70	65	52	35	30								
14	136	134	130	128	126	119	115	108	104	102	96	90	81	75	63	46	41								
14½	147	146	141	139	137	131	127	119	115	113	107	102	92	87	74	57	52	32	25						
15	159	157	153	151	148	142	138	131	126	125	118	113	104	98	86	68	64	44	36						
15½	171	169	165	163	160	154	150	143	138	137	130	125	116	110	98	80	76	56	48	35					
16	183	182	177	175	173	167	163	155	151	149	143	138	128	123	110	93	88	68	61	47					
17	209	207	203	201	199	192	188	181	177	175	169	163	154	148	136	119	114	94	86	73					
18	237	235	231	228	226	220	216	209	204	203	196	191	182	176	164	146	141	122	114	101	53				
19	266	264	260	258	255	249	245	238	233	232	225	220	211	205	193	175	170	151	143	130	82				
20	296	295	290	288	286	280	276	268	264	262	256	251	241	236	223	206	201	182	174	160	113	42			
21	329	327	323	320	318	312	308	301	296	295	288	283	274	268	256	238	233	214	206	192	145	74			
22	362	360	356	354	352	346	342	334	330	328	322	316	307	302	289	272	267	247	240	226	179	108	66		
23	398	396	392	390	387	381	377	370	365	364	357	352	343	337	325	307	302	283	275	262	214	143	101	52	
24	435	433	429	426	424	418	414	407	402	401	394	389	380	374	362	344	339	320	312	298	251	180	138	89	
25	473	471	467	465	463	456	452	445	441	439	432	427	418	412	400	382	378	358	350	337	290	218	177	128	
26						496	492	485	481	479	472	467	458	452	440	422	418	398	390	377	330	258	217	169	60
27													500	494	482	464	460	440	432	419	372	300	258	210	101
28																		483	475	462	415	343	302	253	144
29																				507	459	388	346	297	189
30																					506	434	393	344	236
31																					554	482	441	392	283
32																					603	532	490	441	333
33																						583	541	492	384
34																						636	594	545	436
35																						690	648	599	491
36																						746	704	655	546

[1]In estimating this value the user of the table is cautioned to make sufficient allowance, based on his knowledge of drilling conditions, for caving, sloughing, etc.



HERE ARE THE *Engineering* REASONS

Why the Baker Ball Type Valve

(Used in Baker Cement Guiding, Floating, Cementing Equipment)

Is the First Choice of Modern Operators

CORRECT DESIGN

The present design of the Baker BALL TYPE Valve didn't "just happen"—it represents the sum total of specialized knowledge and experience gained over a period of years in the development and manufacture of back-pressure valves for floating and cementing casing.

As shown in Figure 1, the Valve Chamber is so designed that the buoyant Bakelite Ball has only a short vertical distance to travel in order to seat against the resilient Rubber Ring (backed by Bakelite and Concrete). The Baker BALL TYPE valve action is not dependent upon springs, stems, or other mechanical devices. Instead, the Ball is operated instantly and automatically by positive NATURAL forces to provide a perfect seal.

Thus, when Running in, the differential hydrostatic pressure holds the buoyant Ball tightly against the Rubber Ring to form a positive, leakproof seal (see Figure 3). During cementing operations, the Ball rests on the three blunt, rounded, supporting fingers of the Valve Stop. (Figure 4)

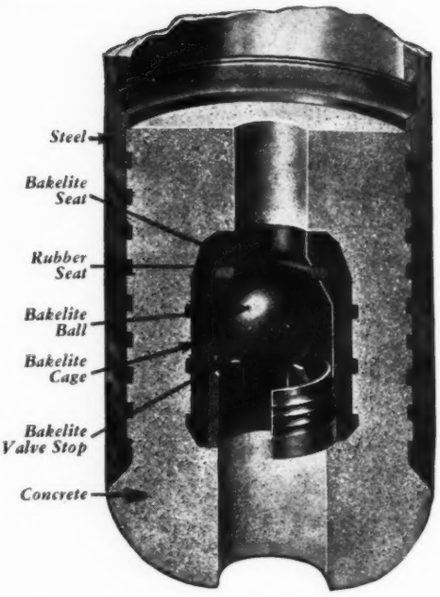


Figure 1. Showing internal construction of the Baker Cement Float Shoe

No Mechanical Obstructions

There are no sharp or projecting mechanical obstructions (such as spring or valve stem) to interfere with instant and positive action of this BALL TYPE Valve. While floating in casing, the valve ALWAYS closes, and remains closed. When circulation is started, the Ball moves away from its seat (see Figure 1) and takes its position resting on the fingers of the Valve Stop. No mechanical means are needed to guide the Ball to its seat—no fragments or other debris can be lodged to prevent positive sealing—no abrasion of the smooth spherical surface will prevent a complete seal against either high or low back-pressure.

BAKER OIL TOOLS, INC.

Telephone JEfferson 8211 – HUNTINGTON PARK, CALIFORNIA – 2959 E. Slauson Ave.
Telephone WAyside 2108 – HOUSTON PLANT AND OFFICE – 6023 Navigation Blvd.

MID-CONTINENT OFFICE AND WAREHOUSE:
Telephone 2-8083 – Tulsa, Oklahoma – 312 East Fourth Street

WEST TEXAS BRANCH OFFICE
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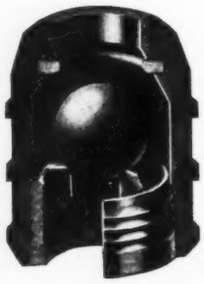


Figure 2. Here is the Bakelite BALL TYPE Valve used in all Baker Floating Units

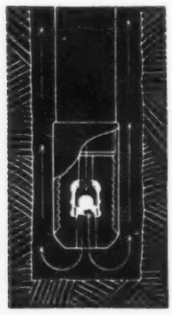


Figure 3. Showing Bakelite Ball seated

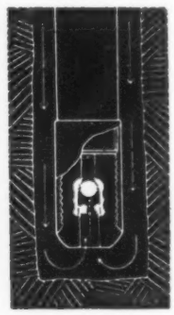


Figure 4. Bakelite Ball unseated during cementing

The BALL TYPE Valve is an EXCLUSIVE BAKER Feature

Before Baker adopted the present BALL TYPE Valve as standard in its Guiding, Floating, and Cementing Equipment, a number of types and designs of valves and valve assemblies were experienced with. In fact, the original Baker Float Shoe, manufactured in 1923 had a cast iron "poppet type" valve. During the refinement of the Baker Float Shoe, cast iron as a material, and the "poppet type" valve, were discarded in favor of non-metallic materials which resulted in the greatly desired Drillability feature and the BALL TYPE Valve which resulted in greater Valve Efficiency.

Today the Baker BALL TYPE Valve is an EXCLUSIVE Baker Feature and is ONE outstanding reason for the widespread preference for Baker Cement Guiding, Floating, Cementing Equipment among modern operators who demand the advantages of VALVE EFFICIENCY, DRILLABILITY AND STRENGTH.

For full details concerning the BALL TYPE Valve used in all Baker Cement Guiding, Floating, Cementing Equipment, see the Baker Section of your 1938 Composite Catalog—or write for your own copy of the INDIVIDUAL Baker Catalog.

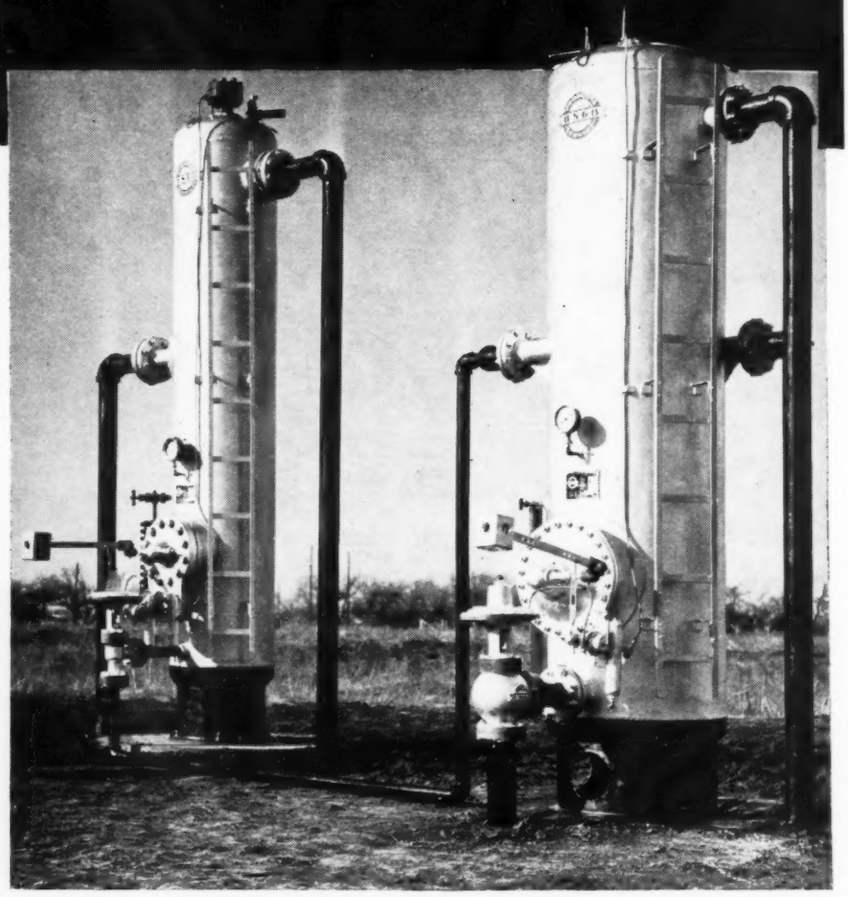
BAKER CEMENT GUIDING FLOATING & CEMENTING EQUIPMENT

VELOCITY[1] OF FLOW, FT. PER SEC., THROUGH 2½-IN. TUBING

Rate of production, bbl. per day	Gas-oil ratio, cu. ft. per bbl.	Tubing pressure at casinghead, lb. per sq. in. gauge								
		0	25	50	75	100	125	150	175	200
50	1000	17.9	6.7	4.1	3.0	2.4	2.0	1.7	1.5	1.3
100		35.8	13.4	8.3	6.0	4.8	3.9	3.4	3.0	2.6
150		53.7	20.1	12.4	9.1	7.1	5.9	5.1	4.4	4.0
200		71.6	26.8	16.6	12.1	9.5	7.9	6.8	5.9	5.3
250		89.5	33.5	20.7	15.1	11.9	9.9	8.4	7.4	6.6
300		107.4	40.1	24.9	18.1	14.3	11.8	10.1	8.9	7.9
350		125.3	46.8	29.0	21.1	16.7	13.8	11.8	10.4	9.2
400		143.2	53.5	33.2	24.1	19.0	15.8	13.5	11.8	10.5
50	1250	22.3	8.3	5.2	3.7	3.0	2.4	2.1	1.8	1.6
100		44.7	16.7	10.3	7.5	5.9	4.9	4.2	3.6	3.2
150		67.0	25.0	15.5	11.2	8.9	7.3	6.3	5.5	4.9
200		89.4	33.4	20.6	15.0	11.8	9.8	8.3	7.3	6.5
250		111.7	41.7	25.8	18.7	14.8	12.2	10.4	9.1	8.1
300		134.1	50.0	30.9	22.5	17.7	14.6	12.5	10.9	9.7
350		156.4	58.4	36.1	26.2	20.7	17.1	14.6	12.8	11.4
400		178.8	66.7	41.2	30.0	23.6	19.5	16.7	14.6	13.0
50	1500	26.8	10.0	6.2	4.5	3.5	2.9	2.5	2.2	1.9
100		53.6	20.0	12.3	9.0	7.0	5.8	5.0	4.3	3.9
150		80.4	30.0	18.5	13.4	10.6	8.7	7.4	6.5	5.8
200		107.2	39.9	24.7	17.9	14.1	11.6	9.9	8.7	7.7
250		134.0	49.9	30.8	22.4	17.6	14.5	12.4	10.8	9.6
300		160.8	59.9	37.0	26.9	21.1	17.5	14.9	13.0	11.6
350		187.6	69.9	43.2	31.3	24.7	20.4	17.4	15.2	13.5
400		214.4	79.9	49.3	35.8	28.2	23.3	19.9	17.4	15.4
50	1750	31.2	11.6	7.2	5.2	4.1	3.4	2.9	2.5	2.2
100		62.5	23.3	14.4	10.4	8.2	6.8	5.8	5.0	4.5
150		93.7	34.9	21.5	15.6	12.2	10.1	8.6	7.5	6.7
200		125.0	46.5	28.7	20.8	16.3	13.5	11.5	10.1	8.9
250		156.2	58.2	35.9	26.0	20.4	16.9	14.4	12.6	11.2
300		187.5	69.8	43.1	31.2	24.5	20.3	17.3	15.1	13.4
350		218.7	81.4	50.2	36.4	28.6	23.6	20.2	17.6	15.6
400		250.0	93.1	57.4	41.6	32.7	27.0	23.0	20.1	17.9
50	2000	35.7	13.3	8.2	5.9	4.7	3.8	3.3	2.9	2.5
100		71.4	26.6	16.4	11.9	9.3	7.7	6.6	5.7	5.1
150		107.1	39.8	24.6	17.8	14.0	11.5	9.8	8.6	7.6
200		142.8	53.1	32.8	23.7	18.6	15.4	13.1	11.4	10.1
250		178.5	66.4	40.9	29.7	23.3	19.2	16.4	14.3	12.7
300		214.2	79.7	49.1	35.6	28.0	23.1	19.7	17.2	15.2
350		249.9	93.0	57.3	41.5	32.6	26.9	22.9	20.0	17.8
400		285.6	106.3	65.5	47.5	37.3	30.8	26.2	22.9	20.3
50	2250	40.1	14.9	9.2	6.7	5.2	4.3	3.7	3.2	2.8
100		80.3	29.9	18.4	13.3	10.5	8.6	7.3	6.4	5.7
150		120.4	44.8	27.6	20.0	15.7	12.9	11.0	9.6	8.5
200		160.6	59.7	36.8	26.7	20.9	17.3	14.7	12.8	11.4
250		200.7	74.6	46.0	33.3	26.2	21.6	18.4	16.0	14.2
300		240.9	89.6	55.2	40.0	31.4	25.9	22.0	19.2	17.1
350		281.0	104.5	64.4	46.6	36.6	30.2	25.7	22.4	19.9
400		321.2	119.4	73.6	53.3	41.9	34.5	29.4	25.6	22.7
50	2500	44.6	16.6	10.2	7.4	5.8	4.8	4.1	3.5	3.1
100		89.2	33.2	20.4	14.8	11.6	9.6	8.1	7.1	6.3
150		133.8	49.7	30.6	22.2	17.4	14.3	12.2	10.6	9.4
200		178.4	66.3	40.8	29.6	23.2	19.1	16.3	14.2	12.6
250		223.0	82.9	51.1	37.0	29.0	23.9	20.4	17.7	15.7
300		267.6	99.5	61.3	44.4	34.8	28.7	24.4	21.3	18.9
350		312.2	116.0	71.5	51.7	40.6	33.5	28.5	24.8	22.0
400		356.8	132.6	81.7	59.1	46.4	38.3	32.6	28.4	25.2

[1]Solution and condensation under pressure are not considered; hence the values are maxima.

INCREASE YOUR PRODUCTION WITHOUT DRAWING ON RESERVES



EARN $13,000 MORE PER YEAR

Two Illinois Petroleum Company wells at Refugio, Texas, were producing through a 700 lb. per square inch B.S.&B. Separator. Then a 125 lb. B.S.&B. Separator was cut into the oil discharge behind the high pressure separator. Production jumped 30 barrels per day! The distillate recovered brings $1.50 per barrel. Thus the low pressure separator will pay for itself in from 12 to 15 days and will add $13,000.00 to the earnings of these two wells per year.

Here's how the enlightened majors see it: Ease the pressure off of your oil gently. Step it through two (or perhaps three) separators. That will save those lighter fractions formerly lost in gas and will, (1) increase your ultimate production, and (2) boost your gravity.

WHAT STAGE SEPARATION WILL DO FOR YOU

Whether you find it easy to make your allowable, or can't make it—there is just so much oil in your pay sand. B.S.&B. Stage Separation—by boosting recovery without extra pull on reserves—provides a way to save oil and make money in one operation, regardless of well capacity.

Ask Your B.S.&B. Man

BS&B

Black, Sivalls & Bryson

(INC.)

OKLAHOMA CITY

MULTIPLIERS FOR CONVERTING MEASURED VOLUME TO VOLUME AT 60 DEGREES FAHRENHEIT

Observed temp., deg. fahr.	10° A.P.I. 1.0 sp. gr.	20° A.P.I. 0.934 sp. gr.	30° A.P.I. 0.876 sp. gr.	40° A.P.I. 0.825 sp. gr.	50° A.P.I. 0.780 sp. gr.	60° A.P.I. 0.739 sp. gr.	70° A.P.I. 0.702 sp. gr.	80° A.P.I. 0.669 sp. gr.	90° A.P.I. 0.639 sp. gr.
60	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
61	.9996	.9996	.9996	.9995	.9995	.9994	.9993	.9992	.9992
62	.9993	.9992	.9992	.9990	.9989	.9988	.9986	.9985	.9983
63	.9989	.9988	.9987	.9986	.9984	.9981	.9979	.9977	.9975
64	.9986	.9984	.9983	.9981	.9978	.9975	.9972	.9970	.9966
65	.9982	.9980	.9979	.9976	.9973	.9969	.9965	.9962	.9958
66	.9978	.9976	.9975	.9971	.9968	.9963	.9958	.9954	.9950
67	.9975	.9972	.9971	.9967	.9962	.9957	.9951	.9947	.9941
68	.9971	.9969	.9966	.9962	.9957	.9950	.9945	.9939	.9933
69	.9968	.9965	.9962	.9958	.9951	.9944	.9938	.9932	.9924
70	.9964	.9961	.9958	.9953	.9946	.9938	.9931	.9924	.9916
71	.9960	.9957	.9954	.9948	.9941	.9932	.9924	.9916	.9908
72	.9957	.9953	.9950	.9943	.9935	.9926	.9917	.9908	.9899
73	.9953	.9949	.9945	.9939	.9930	.9919	.9910	9901	.9891
74	.9950	.9945	.9941	.9934	.9924	.9913	.9903	.9893	.9882
75	.9946	.9941	.9937	.9929	.9919	.9907	.9896	.9885	.9874
76	.9942	.9937	.9933	.9924	.9913	.9901	.9889	.9877	.9866
77	.9939	.9933	.9928	.9919	.9908	.9895	.9882	.9870	.9857
78	.9935	.9930	.9924	.9915	.9902	.9888	.9875	.9862	.9849
79	.9932	.9926	.9919	.9910	.9897	.9882	.9868	.9855	.9840
80	.9928	.9922	.9915	.9905	.9891	.9876	.9861	.9847	.9832
81	.9924	.9918	.9911	.9900	.9886	.9870	.9854	.9839	.9823
82	.9921	.9914	.9907	.9895	.9880	.9863	.9847	.9832	.9815
83	.9917	.9910	.9902	.9891	.9875	.9857	.9840	.9824	.9806
84	.9914	.9906	.9898	.9886	.9869	.9850	.9833	.9817	.9798
85	.9910	.9902	.9894	.9881	.9864	.9844	.9826	.9809	.9789
86	.9906	.9898	.9890	.9876	.9859	.9838	.9819	.9801	.9781
87	.9903	.9894	.9886	.9872	.9853	.9832	.9812	.9793	.9772
88	.9899	.9891	.9881	.9867	.9848	.9825	.9806	.9786	.9764
89	.9896	.9887	.9877	.9863	.9842	.9819	.9799	.9778	.9755
90	.9892	.9883	.9873	.9858	.9837	.9813	.9792	.9770	.9747
91	.9888	.9879	.9869	.9853	.9832	.9807			
92	.9885	.9875	.9865	.9848	.9826	.9801			
93	.9881	.9871	.9860	.9844	.9821	.9794			
94	.9878	.9867	.9856	.9839	.9815	.9788			
95	.9874	.9863	.9852	.9834	.9810	.9782			
96	.9870	.9859	.9848	.9829	.9805	.9776			
97	.9867	.9855	.9844	.9825	.9799	.9770			
98	.9863	.9852	.9839	.9820	.9794	.9763			
99	.9860	.9848	.9835	.9816	.9788	.9757			
100	.9856	.9844	.9831	.9811	.9783	.9751			
101	.9852	.9840	.9827	.9806	.9778	.9745			
102	.9849	.9836	.9823	.9801	.9772	.9739			
103	.9845	.9833	.9818	.9797	.9767	.9732			
104	.9842	.9829	.9814	.9792	.9761	.9726			
105	.9838	.9825	.9810	.9787	.9756	.9720			
106	.9834	.9821	.9806	.9782	.9751	.9714			
107	.9831	.9817	.9802	.9777	.9745	.9708			
108	.9827	.9814	.9797	.9773	.9740	.9701			
109	.9824	.9810	.9793	.9768	.9734	.9695			
110	.9820	.9806	.9789	.9763	.9729	.9689			
111	.9816	.9802	.9785	.9758	.9724	.9683			
112	.9813	.9798	.9781	.9753	.9718	.9676			
113	.9809	.9794	.9776	.9749	.9713	.9670			
114	.9806	.9790	.9772	.9744	.9707	.9663			
115	.9802	.9786	.9768	.9739	.9702	.9657			
116	.9799	.9782	.9764	.9734	.9696	.9651			
117	.9795	.9778	.9760	.9730	.9691	.9645			
118	.9792	.9775	.9755	.9725	.9685	.9638			
119	.9788	.9771	.9751	.9721	.9680	.9632			
120	.9785	.9767	.9747	.9716	.9674	.9626			

LUNKENHEIMER 125 lb. SP BRONZE GATE VALVES

Double Wedge Disc
Taper Seat
Rising Stem

Single Wedge Disc
Taper Seat
Non-rising Stem

These two valves offer many advantages to users of 125 lb. SP bronze gate valves.

Their design provides unusual strength and ruggedness—accurate machining is to close tolerances—materials exceed accepted standards. In short they possess the inherent quality, characteristic of all Lunkenheimer Valves, which means they will stay tight and will give added values in long service life and low cost upkeep.

For detailed design and construction features write for circular No. 544 shown below or ask your Lunkenheimer distributor for a copy.

THE LUNKENHEIMER CO.
"QUALITY"
CINCINNATI, OHIO, U. S. A.
NEW YORK CHICAGO
BOSTON PHILADELPHIA
EXPORT DEPT. 318-322 HUDSON ST., NEW YORK

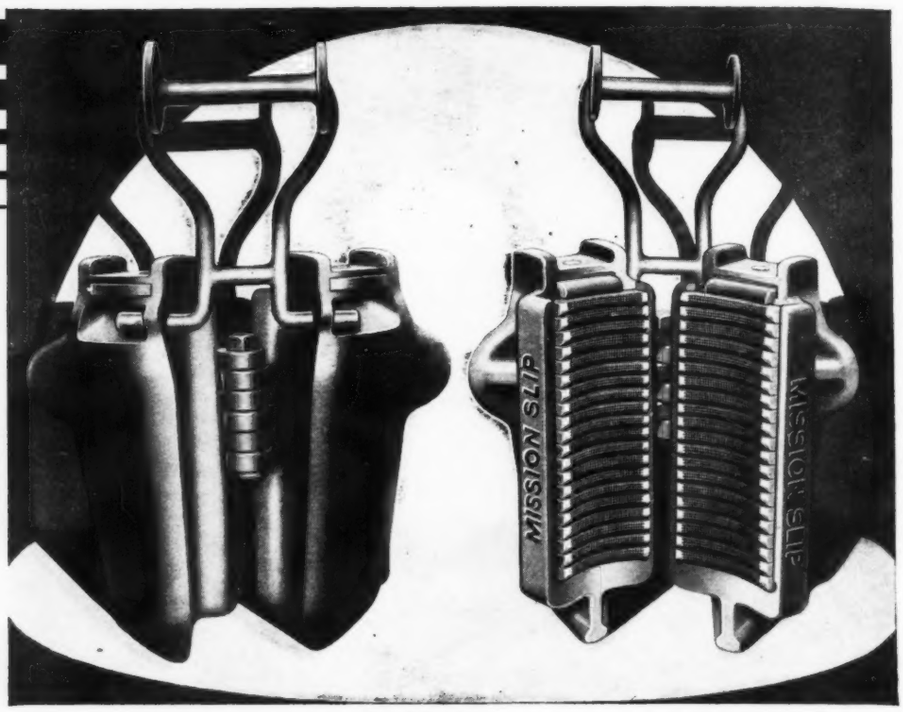
BOILER MOUNTINGS — LUNKENHEIMER VALVES — LUBRICATING DEVICES

WEIGHT AND VOLUME OF 2⅞-IN. DRILL PIPE

Length of string of drill pipe, ft.	6.45 lb. drill pipe				8.35 lb. drill pipe				10.40 lb. drill pipe			
	Weight, coupled,[1] lb.	Volume of fluid displaced, gal.	Weight of 9.5 lb./gal. fluid displaced, lb.	Net weight of drill pipe, lb.	Weight, coupled,[1] lb.	Volume of fluid displaced, gal.	Weight of 9.5 lb./gal. fluid displaced, lb.	Net weight of drill pipe, lb.	Weight, coupled,[1] lb.	Volume of fluid displaced, gal.	Weight of 9.5 lb./gal. fluid displaced, lb.	Net weight of drill pipe, lb.
2,000	12,900	197.1	1,875	11,025	16,700	255.2	2,425	14,275	20,800	317.8	3,020	17,780
2,200	14,190	216.8	2,060	12,130	18,370	280.7	2,665	15,705	22,880	349.6	3,320	19 560
2,400	15,480	236.5	2,245	13,235	20,040	306.2	2,910	17,130	24,960	381.4	3,625	21,335
2,600	16,770	256.3	2,435	14,335	21,710	331.7	3,150	18,560	27,040	413.2	3,925	23,115
2,800	18,060	276.0	2,620	15,440	23,380	357.3	3,395	19,985	29,120	445.0	4,225	24,895
3,000	19,350	295.7	2,810	16,540	25,050	382.8	3,635	21,415	31,200	476.8	4,530	26,670
3,200	20,640	315.4	2,995	17,645	26,720	408.3	3,880	22,840	33,280	508.5	4,830	28,450
3,400	21,930	335.1	3,185	18,745	28,390	433.8	4,120	24,270	35,360	540.3	5,135	30,225
3,600	23,220	354.8	3,370	19,850	30,060	459.3	4,365	25,695	37,440	572.1	5,435	32,005
3,800	24,510	374.5	3,560	20,950	31,730	484.9	4,605	27,125	39,520	603.9	5,735	33,785
4,000	25,800	394.2	3,745	22,055	33,400	510.4	4,850	28,550	41,600	635.7	6,040	35,560
4,200	27,090	414.0	3,935	23,155	35,070	535.9	5,090	29,980	43,680	667.5	6,240	37,340
4,400	28,380	433.7	4,120	24,260	36,740	561.4	5,335	31,405	45,760	699.2	6,645	39,115
4,600	29,670	453.4	4,305	25,365	38,410	586.9	5,575	32,835	47,840	731.0	6,945	40,895
4,800	30,960	473.1	4,495	26,465	40,080	612.4	5,820	34,260	49,920	762.8	7,245	42,675
5,000	32,250	492.8	4,680	27,570	41,750	638.0	6,060	35,690	52,000	794.6	7,550	44,450
5,200	33,540	512.5	4,870	28,670	43,420	663.5	6,305	37,115	54,080	826.4	7,850	46,230
5,400	34,830	532.2	5,055	29,775	45,090	689.0	6,545	38,545	56,160	858.2	8,155	48,005
5,600	36,120	551.9	5,245	30,875	46,760	714.5	6,790	39,970	58,240	889.9	8,455	49,785
5,800	37,410	571.6	5,430	31,980	48,430	740.0	7,030	41,400	60,320	921.7	8,755	51,565
6,000	38,700	591.4	5,620	33,080	50,100	765.6	7,275	42,825	62,400	953.5	9,060	53,340
6,200	39,990	611.1	5,805	34,185	51,770	791.1	7,515	44,255	64,480	985.3	9,360	55,120
6,400	41,280	630.8	5,990	35,290	53,440	816.6	7,760	45,680	66,560	1017.1	9,660	56,900
6,600	42,570	650.5	6,180	36,390	55,110	842.1	8,000	47,110	68,640	1048.9	9,965	58,675
6,800	43,860	670.2	6,365	37,495	56,780	867.6	8,245	48,535	70,720	1080.6	10,265	60,455
7,000	45,150	689.9	6,555	38,595	58,450	893.2	8,485	49,965	72,800	1112.4	10,570	62,230
7,200	46,440	709.6	6,740	39,700	60,120	918.7	8,725	51,395	74,880	1144.2	10,870	64,010
7,400	47,730	729.3	6,930	40,800	61,790	944.2	8,970	52,820	76,960	1176.0	11,170	65,790
7,600	49,020	749.1	7,115	41,905	63,460	969.7	9,210	54,250	79,040	1207.8	11,475	67,565
7,800	50,310	768.8	7,305	43,005	65,130	995.2	9,455	55,675	81,120	1239.6	11,775	69,345
8,000	51,600	788.5	7,490	44,110	66,800	1020.7	9,695	57,105	83,200	1271.3	12,080	71,120
8,200	52 890	808.2	7,680	45,210	68 470	1046.3	9,940	58,530	85,280	1303.1	12,380	72 900
8,400	54,180	827.9	7,865	46,315	70,140	1071.8	10,180	59,960	87,360	1334.9	12,680	74,680
8,600	55,470	847.6	8,050	47,420	71,810	1097.3	10,425	61,385	89,440	1366.7	12,985	76.455
8,800	56,760	867.3	8,240	48,520	73,480	1122.8	10,665	62,815	91,520	1398.5	13,285	78,235
9,000	58,050	887.0	8,425	49,625	75,150	1148.3	10,910	64,240	93,600	1430.3	13,590	80,010
9,200	59,340	906.8	8,615	50,725	76,820	1173.9	11,150	65,670	95,680	1462.1	13,890	81,790
9,400	60,630	926.5	8,800	51,830	78,490	1199.4	11,395	67,095	97,760	1493.8	14,190	83,570
9,600	61,920	946.2	8,990	52,930	80,160	1224.9	11,635	68,525	99,840	1525.6	14,495	85,345
9,800	63,210	965.9	9,175	54,035	81,830	1250.4	11,880	69,950	101,920	1557.4	14,795	87,125
10,000	64,500	985.6	9,365	55,135	83,500	1275.9	12,120	71,380	104,000	1589.2	15,095	88,905
10,200	65,790	1005.3	9,550	56,240	85,170	1301.5	12,365	72,805	106,080	1621.0	15,400	90,680
10,400	67,080	1025.0	9,740	57,340	86,840	1327.0	12,605	74,235	108,160	1652.8	15,700	92,460
10,600	68,370	1044.7	9,925	58,445	88,510	1352.5	12,850	75,660	110,240	1684.5	16,005	94,235
10,800	69,660	1064.4	10,110	59,550	90,180	1378.0	13,090	77,090	112,320	1716.3	16,305	96,015
11,000	70,950	1084.2	10,300	60,650	91,850	1403.5	13,335	78,515	114,400	1748.1	16,605	97,795
11,200	72,240	1103.9	10,485	61,755	93,520	1429.0	13,575	79,945	116,480	1779.9	16,910	99,570
11,400	73 530	1123.6	10,675	62,855	95,190	1454.6	13,820	81,370	118,560	1811.7	17,210	101,350
11,600	74,820	1143.3	10,860	63,960	96,860	1480.1	14,060	82,800	120,640	1843.5	17,515	103,125
11,800	76,110	1163.0	11,050	65,060	98,530	1505.6	14,305	84,225	122,720	1875.2	17,815	104,905
12,000	77,400	1182.7	11,235	66,165	100,200	1531.1	14,545	85,655	124,800	1907.0	18,115	106,685
12,200	78 690	1202.4	11,425	67,265	101,870	1556.6	14,790	87,080	126,880	1938.8	18,420	108,460
12,400	79,980	1222.1	11,610	68,370	103,540	1582.2	15,030	88,510	128,960	1970.6	18,720	110,240
12,600	81,270	1241.9	11,800	69,470	105,210	1607.7	15,275	89,935	131,040	2002.4	19,025	112,015
12,800	82,560	1261.6	11,985	70,575	106,880	1633.2	15,515	91,365	133,120	2034.2	19,325	113,795
13,000	83,850	1281.3	12,170	71,680	108,550	1658.7	15,760	92,790	135,200	2065.9	19,625	115,575

[1]If a regular tool joint is inserted every 90 ft. all values for 6.45-lb. drill pipe will be increased about 2.5 percent, for 8.35-lb. drill pipe about 1.8 percent, and for 10.40-lb. drill pipe about 1.3 percent.

ROUND TRIPS MADE QUICKLY



with MISSION SLIPS

The greatest cause of delay in handling pipe, sticking in bowl, is positively eliminated through that outstanding principle which distinguishes Mission Slips from all others

• • • • **ROLLING DOGS** • • • •

INSTANT RELEASE IS ASSURED because the dogs lift away from the pipe as it is pulled.

FAST HANDLING OF PIPE SAVES MONEY

MISSION MANUFACTURING CO.

HUMBLE ROAD - - - - - - - - - - - - - - - - - HOUSTON, TEXAS

Export Office: 30 Rockefeller Plaza, New York

Mission Slips . . Mission Valves . . Mission Pistons . . Mission Piston Rods . . Mission Swabs

Sold Through Supply Stores Everywhere

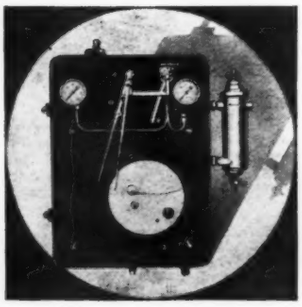
DENSITY AND ACID CONTENT OF SULPHURIC ACID SOLUTIONS (20° C or 68° F)

Weight percent H_2SO_4	Sp. gr.	Gravity, deg. Bé.	Grams H_2SO_4 per liter	Lb. H_2SO_4 per gal.	Weight percent H_2SO_4	Sp. gr.	Gravity, deg. Bé.	Grams H_2SO_4 per liter	Lb. H_2SO_4 per gal.
1	1.0051	0.7	10.05	0.0839	51	1.4049	41.8	716.5	5.979
2	1.0118	1.7	20.24	0.1689	52	1.4148	42.5	735.7	6.140
3	1.0184	2.6	30.55	0.2550	53	1.4248	43.2	755.1	6.302
4	1.0250	3.5	41.00	0.3422	54	1.4350	44.0	774.9	6.467
5	1.0317	4.5	51.59	0.4305	55	1.4453	44.7	794.9	6.634
6	1.0385	5.4	62.31	0.5200	56	1.4557	45.4	815.2	6.803
7	1.0453	6.3	73.17	0.6106	57	1.4662	46.1	835.7	6.974
8	1.0522	7.2	84.18	0.7025	58	1.4768	46.8	856.5	7.148
9	1.0591	8.1	95.32	0.7955	59	1.4875	47.5	877.6	7.324
10	1.0661	9.0	106.6	0.8897	60	1.4983	48.2	899.0	7.502
11	1.0731	9.9	118.0	0.9851	61	1.5091	48.9	920.6	7.682
12	1.0802	10.8	129.6	1.082	62	1.5200	49.6	942.4	7.865
13	1.0874	11.7	141.4	1.180	63	1.5310	50.3	964.5	8.049
14	1.0947	12.5	153.3	1.279	64	1.5421	51.0	986.9	8.236
15	1.1020	13.4	165.3	1.379	65	1.5533	51.7	1010	8.426
16	1.1094	14.3	177.5	1.481	66	1.5646	52.3	1033	8.618
17	1.1168	15.2	189.9	1.584	67	1.5760	53.0	1056	8.812
18	1.1243	16.0	202.4	1.689	68	1.5874	53.7	1079	9.008
19	1.1318	16.9	215.0	1.795	69	1.5989	54.3	1103	9.207
20	1.1394	17.7	227.9	1.902	70	1.6105	55.0	1127	9.408
21	1.1471	18.6	240.9	2.010	71	1.6221	55.6	1152	9.611
22	1.1548	19.4	254.1	2.120	72	1.6338	56.3	1176	9.817
23	1.1626	20.3	267.4	2.231	73	1.6456	56.9	1201	10.02
24	1.1704	21.1	280.9	2.344	74	1.6574	57.5	1226	10.24
25	1.1783	21.9	294.6	2.458	75	1.6692	58.1	1252	10.45
26	1.1862	22.8	308.4	2.574	76	1.6810	58.7	1278	10.66
27	1.1942	23.6	322.4	2.691	77	1.6927	59.3	1303	10.88
28	1.2023	24.4	336.6	2.809	78	1.7043	59.9	1329	11.09
29	1.2104	25.2	351.0	2.929	79	1.7158	60.5	1355	11.31
30	1.2185	26.0	365.6	3.051	80	1.7272	61.1	1382	11.53
31	1.2267	26.8	380.3	3.173	81	1.7383	61.6	1408	11.75
32	1.2349	27.6	395.2	3.298	82	1.7491	62.1	1434	11.97
33	1.2432	28.4	410.3	3.424	83	1.7594	62.6	1460	12.19
34	1.2515	29.1	425.5	3.551	84	1.7693	63.0	1486	12.40
35	1.2599	29.9	441.0	3.680	85	1.7786	63.5	1512	12.62
36	1.2684	30.7	456.6	3.811	86	1.7872	63.9	1537	12.83
37	1.2769	31.4	472.5	3.943	87	1.7951	64.2	1562	13.03
38	1.2855	32.2	488.5	4.077	88	1.8022	64.5	1586	13.23
39	1.2941	33.0	504.7	4.212	89	1.8087	64.8	1610	13.43
40	1.3028	33.7	521.1	4.349	90	1.8144	65.1	1633	13.63
41	1.3116	34.5	537.8	4.488	91	1.8195	65.3	1656	13.82
42	1.3205	35.2	554.6	4.628	92	1.8240	65.5	1678	14.00
43	1.3294	35.9	571.6	4.770	93	1.8279	65.7	1700	14.19
44	1.3384	36.7	588.9	4.914	94	1.8312	65.8	1721	14.36
45	1.3476	37.4	606.4	5.061	95	1.8337	65.9	1742	14.54
46	1.3569	38.1	624.2	5.209	96	1.8355	66.0	1762	14.70
47	1.3663	38.9	642.2	5.359	97	1.8364	66.0	1781	14.87
48	1.3758	39.6	660.4	5.511	98	1.8361	66.0	1799	15.02
49	1.3854	40.3	678.8	5.665	99	1.8342	65.9	1816	15.15
50	1.3951	41.1	697.6	5.821	100	1.8305	65.8	1831	15.28

The Baumé scale is that for liquids having density greater than that of water.

TYPICAL APPLICATIONS: MAINTAINING THE RATE OF FLOW OF GASES OR LIQUIDS AT A DEFINITE VALUE . . . CONTROLLING THE RATE OF FLOW OF LIQUID OR GAS IN ONE LINE PROPORTIONAL WITH THE RATE OF FLOW IN ANOTHER LINE . . . AND FOR A WIDE RANGE OF PURPOSES SUCH AS CONTROL OF LIQUIDS IN TOWERS AND STILLS.

• Simplicity is the first principle of effective low cost. This little pilot valve vastly simplifies rate-volume control and liquid level control. Definite operating economies are gained. Ruggedness is vastly increased. Many of the usual adjustments are rendered obsolete; for instance: Capacity tanks . . . Outlet throttle valves . . . Adjustable leaks. One simple micrometer screw increases or decreases the rate of flow. All adjustments are made without removing the chart or the chart dial. Engineering bulletin E-5 fully describes applications and operation. It will be mailed you on request.



218A

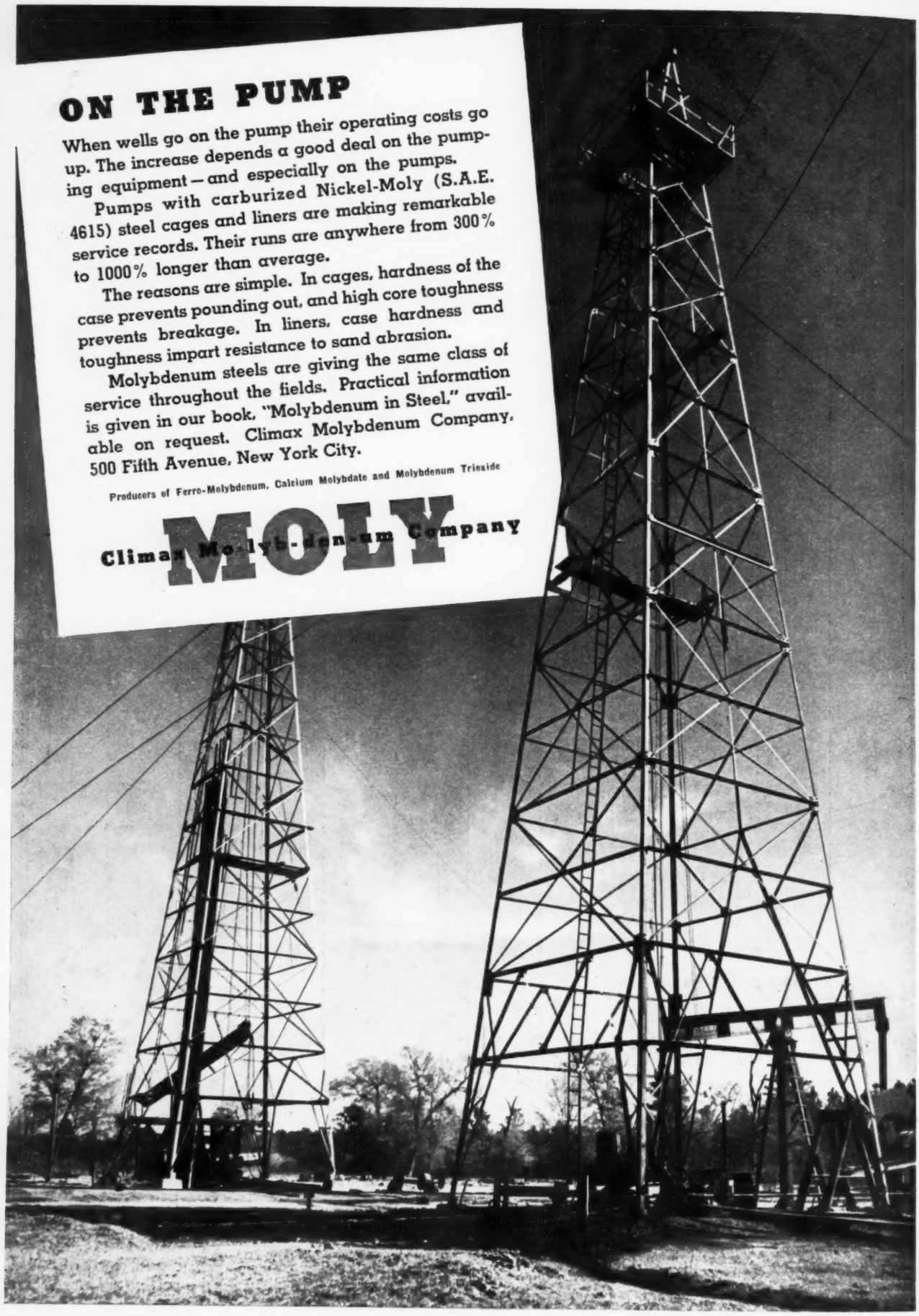
• Also available . . . Complete information on the new Metric Remote Air-Actuated Reset Controller . . . And bulletin EG2 and E3 on Indicating, Recording and Integrating Flowmeters.

AMERICAN METER COMPANY
INCORPORATED
Measurement and control of Gas, Oil, Steam, Air and Liquids
ESTABLISHED 1836
METRIC METAL WORKS • ERIE, PA.

WEIGHT, LB., OF PLAIN TUBING, EMPTY AND FULL OF FLUID[1]

Length of tubing string, ft.	Wt. of ¾-in. rods, lb.	Nominal size of tubing									
		2-in.		2½-in.		3-in.		3½-in.		4-in.	
		Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet
500	820	2,300	2,845	3,200	4,055	4,600	5,935	4,750	6,660	6,300	8,700
600	984	2,760	3,410	3,840	4,870	5,520	7,120	5,700	7,990	7,560	10,440
700	1,148	3,220	3,980	4,480	5,680	6,440	8,305	6,650	9,325	8,820	12,180
800	1,312	3,680	4,550	5,120	6,490	7,360	9,490	7,600	10,655	10,080	13,920
900	1,476	4,140	5,115	5,760	7,305	8,280	10,680	8,550	11,990	11,340	15,660
1000	1,640	4,600	5,685	6,400	8,115	9,200	11,865	9,500	13,320	12,600	17,400
1100	1,804	5,060	6,255	7,040	8,925	10,120	13,050	10,450	14,655	13,860	19,140
1200	1,968	5,520	6,825	7,680	9,735	11,040	14,240	11,400	15,985	15,120	20,880
1300	2,132	5,980	7,390	8,320	10,550	11,960	15,425	12,350	17,315	16,380	22,620
1400	2,296	6,440	7,960	8,960	11,360	12,880	16,610	13,300	18,650	17,640	24,360
1500	2,460	6,900	8,530	9,600	12,170	13,800	17,800	14,250	19,980	18,900	26,100
1600	2,624	7,360	9,095	10,240	12,985	14,720	18,985	15,200	21,315	20,160	27,835
1700	2,788	7,820	9,665	10,880	13,795	15,640	20,170	16,150	22,645	21,420	29,575
1800	2,952	8,280	10,235	11,520	14,605	16,560	21,360	17,100	23,975	22,680	31,315
1900	3,116	8,740	10,805	12,160	15,415	17,480	22,545	18,050	25,310	23,940	33,055
2000	3,280	9,200	11,370	12,800	16,230	18,400	23,730	19,000	26,640	25,200	34,795
2100	3,444	9,660	11,940	13,440	17,040	19,320	24,915	19,950	27,975	26,460	36,535
2200	3,608	10,120	12,510	14,080	17,850	20,240	26,105	20,900	29,305	27,720	38,275
2300	3,772	10,580	13,075	14,720	18,665	21,160	27,290	21,850	30,635	28,980	40,015
2400	3,936	11,040	13,645	15,360	19,475	22,080	28,475	22,800	31,970	30,240	41,755
2500	4,100	11,500	14,215	16,000	20,285	23,000	29,665	23,750	33,300	31,500	43,495
2600	4,264	11,960	14,785	16,640	21,095	23,920	30,850	24,700	34,635	32,760	45,235
2700	4,428	12,420	15,350	17,280	21,910	24,840	32,035	25,650	35,965	34,020	46,975
2800	4,592	12,880	15,920	17,920	22,720	25,760	33,225	26,600	37,300	35,280	48,715
2900	4,756	13,340	16,490	18,560	23,530	26,680	34,410	27,550	38,630	36,540	50,455
3000	4,920	13,800	17,055	19,200	24,345	27,600	35,595	28,500	39,960	37,800	52,195
3100	5,084	14,260	17,625	19,840	25,155	28,520	36,780	29,450	41,295	39,060	53,935
3200	5,248	14,720	18,195	20,480	25,965	29,440	37,970	30,400	42,625	40,320	55,675
3300	5,412	15,180	18,765	21,120	26,775	30,360	39,155	31,350	43,960	41,580	57,415
3400	5,576	15,640	19,330	21,760	27,590	31,280	40,340	32,300	45,290	42,840	59,155
3500	5,740	16,100	19,900	22,400	28,400	32,200	41,530	33,250	46,620	44,100	60,895
3600	5,904	16,560	20,470	23,040	29,210	33,120	42,715	34,200	47,955	45,360	62,635
3700	6,068	17,020	21,035	23,680	30,025	34,040	43,900	35,150	49,285	46,620	64,375
3800	6,232	17,480	21,605	24,320	30,835	34,960	45,090	36,100	50,620	47,880	66,115
3900	6,396	17,940	22,175	24,960	31,645	35,880	46,275	37,050	51,950	49,140	67,855
4000	6,560	18,400	22,745	25,600	32,455	36,800	47,460	38,000	53,280	50,400	69,595
4100	6,724	18,860	23,310	26,240	33,270	37,720	48,650	38,950	54,615	51,660	71,335
4200	6,888	19,320	23,880	26,880	34,080	38,640	49,835	39,900	55,945	52,920	73,075
4300	7,052	19,780	24,450	27,520	34,890	39,560	51,020	40,850	57,280	54,180	74,815
4400	7,216	20,240	25,015	28,160	35,700	40,480	52,205	41,800	58,610*	55,440	76,555*
4500	7,380	20,700	25,585	28,800	36,515	41,400	53,395	42,750	59,945	56,700	78,295
4600	7,544	21,160	26,155	29,440	37,325	42,320	54,580	43,700	61,275	57,960	80,035
4700	7,708	21,620	26,725	30,080	38,135	43,240	55,765	44,650	62,605	59,220	81,770
4800	7,872	22,080	27,290	30,720	38,950	44,160	56,955*	45,600	63,940	60,480	83,510
4900	8,036	22,540	27,860	31,360	39,760	45,080	58,140	46,550	65,270	61,740	85,250
5000	8,200	23,000	28,430	32,000	40,570	46,000	59,325	47,500	66,605	63,000	86,990
5100	8,364	23,460	28,995	32,640	41,380*	46,920	60,515	48,450	67,935	64,260	88,730
5200	8,528	23,920	29,565*	33,280	42,195	47,840	61,700	49,400	69,265	65,520	90,470
5300	8,692	24,380	30,135	33,920	43,005	48,760	62,885	50,350	70,600	66,780	92,210
5400	8,856	24,840	30,705	34,560	43,815	49,680	64,075	51,300	71,930	68,040	93,950
5500	9,020	25,300	31,270	35,200	44,630	50,600	65,260	52,250	73,265	69,300	95,690
5600	9,184	25,760	31,840	35,840	45,440	51,520	66,445	53,200	74,595	70,560	97,430
5700	9,348	26,220	32,410	36,480	46,250	52,440	67,630	54,150	75,925	71,820	99,170
5800	9,512	26,680	32,975	37,120	47,060	53,360	68,820	55,100	77,260	73,080	100,910
5900	9,676	27,140	33,545	37,760	47,875	54,280	70,005	56,050	78,590	74,340	102,650
6000	9,840	27,600	34,115	38,400	48,685	55,200*	71,190	57,000*	79,925	75,600*	104,390
6500	10,660	29,900*	36,955	41,600*	52,740	59,800	77,125	61,750	86,585	81,900	113,090
7000	11,480	32,200	39,800	44,800	56,800	64,400	83,055	66,500	93,245	88,200	121,790
7500	12,300	34,500	42,645	48,000	60,855	69,000	88,990	71,250	99,905	94,500	130,490
8000	13,120	36,800	45,485	51,200	64,915	73,600	94,920	76,000	106,565	100,800	139,185

[1]Based on 20 deg. A.P.I. fluid. Allowance has been made for fluid displaced by ¾-in. rods.
*Limit of tensile strength of Grade C seamless tubing; safety factor of 2 used.


ON THE PUMP
When wells go on the pump their operating costs go up. The increase depends a good deal on the pumping equipment—and especially on the pumps.
Pumps with carburized Nickel-Moly (S.A.E. 4615) steel cages and liners are making remarkable service records. Their runs are anywhere from 300% to 1000% longer than average.
The reasons are simple. In cages, hardness of the case prevents pounding out, and high core toughness prevents breakage. In liners, case hardness and toughness impart resistance to sand abrasion.
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